

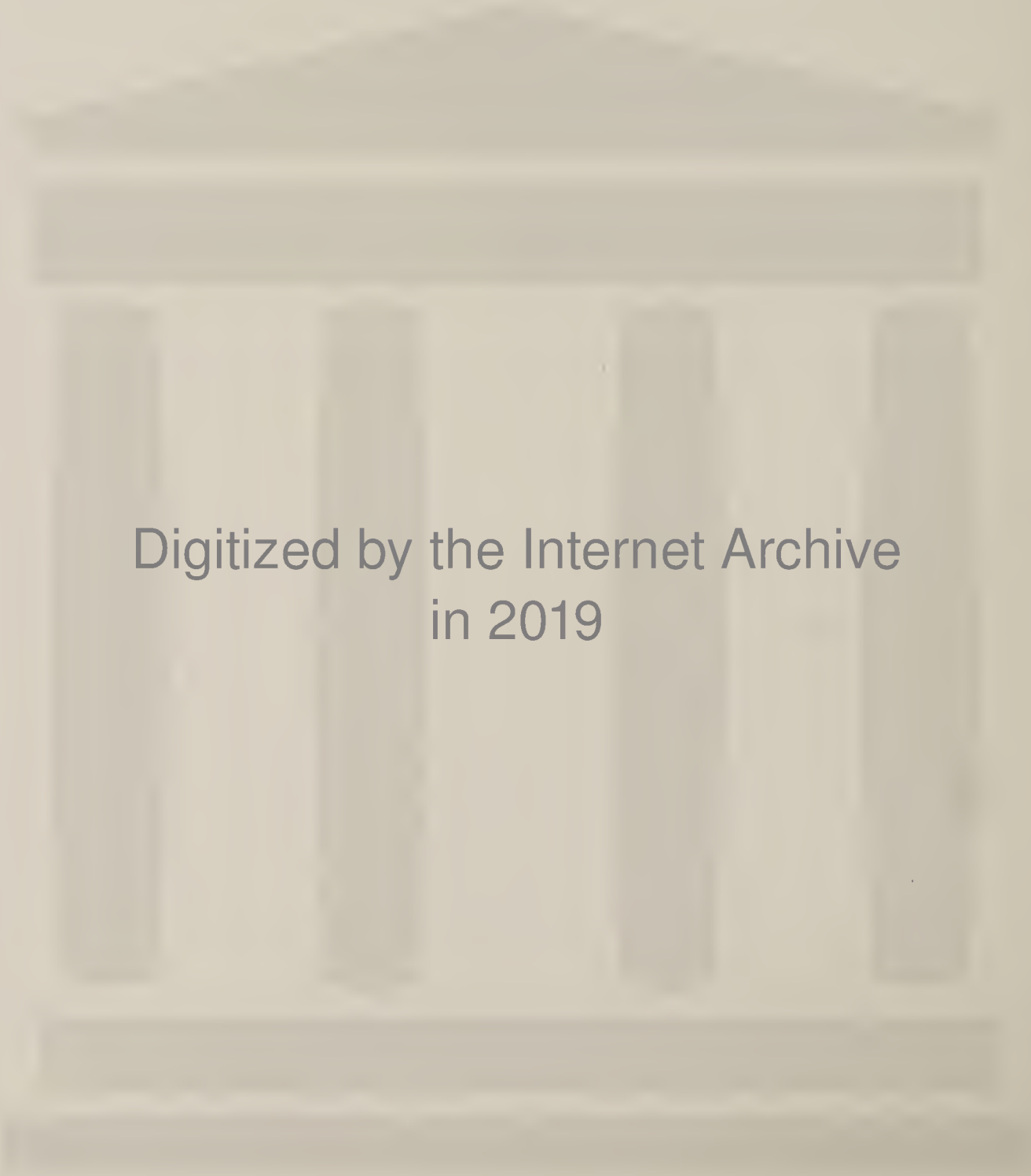
THE

ENERGY Casebook

Casebook #2
of Rocky Mountain
Institute's
Economic Renewal
Program



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ENERGY CASEBOOK

by William D. Browning and L. Hunter Lovins



Casebook #2, Economic Renewal Program

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This casebook is one component of the larger Economic Renewal Program — a series of community workshops in which as many as seventeen workbooks and casebooks are used by community residents as they examine their town's unique problems and assets, explore examples from hundreds of communities, mobilize existing skills and resources, and develop specific projects to renew the local economy.

The companion to the *Business Opportunities Casebook*, the *Business Opportunities Workbook*, provides a step-by-step guide to identifying development opportunities in your community, and then choosing and evaluating specific projects to strengthen your local economy. Rocky Mountain Institute is also developing workbooks and casebooks for specific sectors of the local economy: energy, food and agriculture, housing, water, waste-management, and health.

For more information on the Economic Renewal Program, or to order publications, contact:

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Introduction

Fostering the efficient use of energy and creating new energy resources will improve your community's economy.

This statement is not just some interesting new idea. It is a fact demonstrated by projects accomplished by communities across the country. Many of these sensible, energy-based economic development projects are documented in these pages so you can determine which, if any, should be adapted for your community's specific conditions.

This casebook explores successful efforts to help individuals, support existing businesses, and encourage the creation of new energy-related business. Some of the material in this casebook also will be useful for electric utilities that are interested in creating energy-related economic development projects. This book can be used on its own or in conjunction with other Economic Renewal Program casebooks and workbooks.

Projects and programs described in this casebook help to strengthen local economies by reducing energy costs, thereby keeping more money in the local economy, and by developing new energy sources that are compatible with the community. These projects are successful because they have one or more of the following characteristics. They

- 1) help individuals and families save energy and, therefore, money.
- 2) help people develop new energy-related job skills.
- 3) support existing businesses by reducing overhead.
- 4) enhance and take advantage of the community's infrastructure.
- 5) contribute to the efficient use and sustainable development of the community's natural resources.
- 6) promote new business and encourage the relocation of businesses by capitalizing on existing resources.
- 7) are affordable and do not overextend the community's resources.

A Different Approach

Conventional economic development programs tend to rely exclusively on outside resources. In contrast, the Economic Renewal Program emphasizes the efficient use of local resources, the full use of local skills, and the development of new business using local resource opportunities.

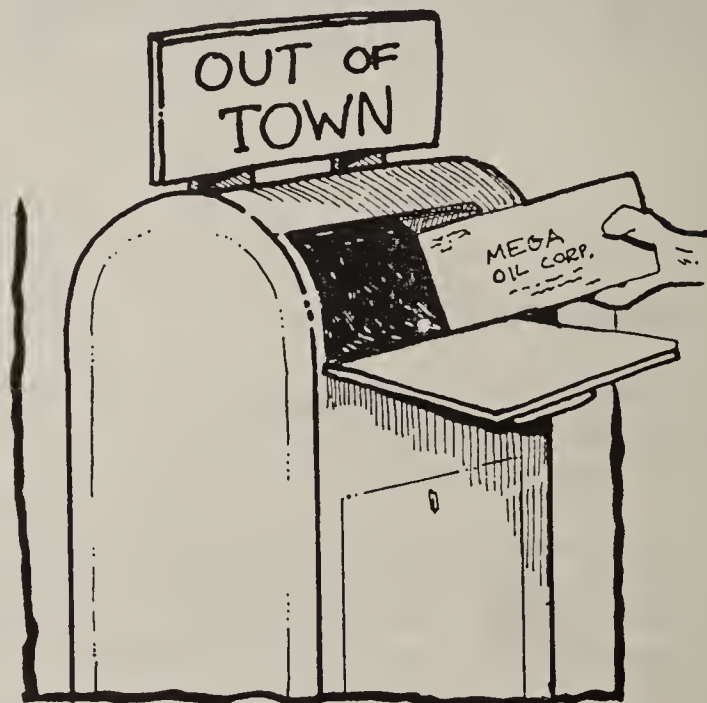
Economic development that depends on outside resources and decisions usually involves attempts to recruit large outside businesses for relocation into a community. This is sometimes called smokestack-chasing. A modern version of this, in search of computer microchip industries, is called chip-chasing. The problem is that recruiting is costly and highly competitive. The cost of getting a firm to choose one community over another may simply be too high for small or distressed communities. Recruiting can be useful, but if it is *relied* upon as the community's only option, it may shortchange surer development opportunities closer to home.

Similarly, reliance on government programs tends to weaken a community, making it overly dependent on outside resources and decisions. Though many state and federal programs are useful and effective, no government program is sufficient for a town's entire development strategy. In addition, government programs may not be available to a particular town.

In contrast, the Economic Renewal Program is based primarily on local skills and resources. Outside resources are used, certainly; but they are not relied upon. ER's practical, comprehensive, and diverse approach is demonstrated by such projects as popular "Buy Local" programs, weatherization, and cogeneration or waste-heat projects. "Buy Local" programs support the purchase of local products. Weatherization projects keep dollars in the local economy by plugging heat-leaks in the community's buildings. Cogeneration / waste-heat projects can help to encourage new businesses by offering waste heat from existing power sources as an energy resource. These programs not only provide support to local businesses, but can result in business expansion and the creation of new businesses.

Economic renewal efforts that use local resources are easier to develop and control. They tend to yield more predictable results than efforts that concentrate exclusively on outside help. These efforts make a community far more attractive to outside businesses and government programs.

Each community is unique. As you read through the ideas discussed in this text, filter them through your community's perspective to see which might best meet your needs. Jot down ideas, notes, and comments in the margins. This casebook contains a few extra pages for taking notes.



Energy and Local Economies

Energy is usually not a hot topic unless there is a shortage or sudden price increase. For many years, few of us thought much about energy. When we flipped on a switch, our lights came on. Driving an ever-growing economy, the machinery of industry guzzled coal, gas, and oil. Energy seemed plentiful. Its future supply seemed guaranteed by such dazzling new technologies as nuclear power, which we were told would give us energy "too cheap to meter." This happy view of energy ended, however, with the Arab oil embargo of 1973 and the Iranian revolution of 1979. Suddenly, energy was

front-page news. Lines formed at gas stations, utility bills soared, and the term "energy crisis" was added to everyone's vocabulary.

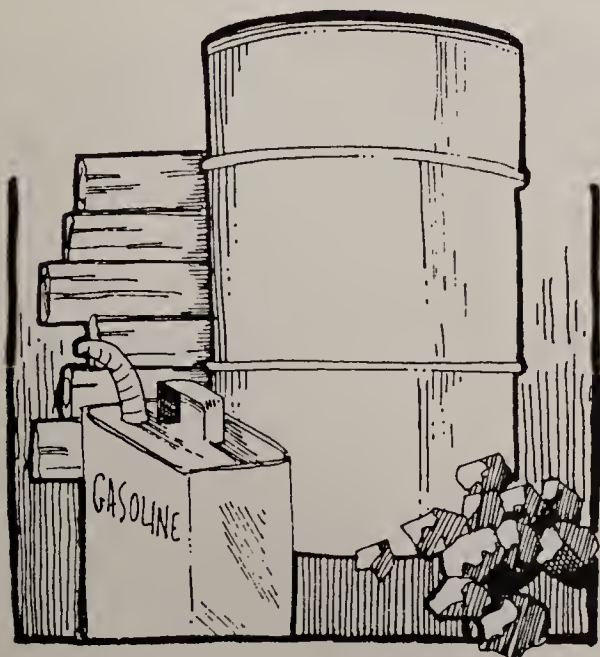
Since then, energy costs have risen significantly. In 1970, the average price of household electricity was two and one-fifth cents per kilowatt-hour. Now it is around eight cents — a 39 % increase beyond general inflation. A gallon of fuel oil cost the same from 1910 to 1970. Since then, its price has risen over 1,000%. Although some price declines occurred in 1985-86, Americans are still paying twice the inflation-corrected price that they paid for energy in 1970.¹

The United States, with about 5% of the world's population, produces about 21% of the world's energy, and consumes about 25%.² The sources of U.S. energy are: coal, 31%; crude oil, 27%; natural gas, 26%; natural gas by-product, 3%; hydroelectric, 4%; nuclear electric, 7%; geothermal, .03%; and other sources. The difference between our production and consumption is made up by oil and natural gas imports (plus electricity from Canada). [It should be noted that federal figures such as these tend to overlook the contribution of some renewable energy sources like wood. Typically, wood annually delivers more energy than nuclear.³] Energy use by economic sector (again omitting renewables) is as follows: residential and commercial sectors, 36.4%; industrial, 35.8%; and transportation, 27.8%. Of all the energy consumed in the U.S., 36.3% is used by

utilities to generate electricity to power these sectors.⁴ All of which might be interesting in a numbers quiz, but what does it mean for local economies?

While everyone may grumble about energy costs when paying monthly bills, few of us realize the effect of energy costs on our local economies. Typically 80 to 90 cents of every dollar spent on energy leaves the community and never returns.⁵ Thus, the amount of money that leaves a community each year can be quite large.

Verdigre, Nebraska, is a farming community with a population of 650 and an annual income of around \$5 million. A study of Verdigre's economy revealed that taxes were the largest single expenditure, costing a total of 15% of the town's income. Tax monies partially return to the community to pay for schools, roads, municipal services, unemployment insurance, and such. However, nearly an equivalent amount is spent outside the community for energy and does not return. In fact, about 70% of the town's \$5 million income leaves the town to pay for energy, processed food, and insurance. As an economist involved in the study said, "With little prospect of generating new markets for its present output, or attracting a new plant to the area, the community basically has two options around which it can generate a sustained return ... import substitution and resource efficiency measures."⁶ Import substitution means replacing an imported resource, like oil, with a locally produced resource, perhaps corn ethanol.



Energy efficiency is different from energy conservation. To some people, energy conservation conveys doing without, or "freezing in the dark." In contrast, efficiency technologies provide the same quality of service as the inefficient technologies they replace, or, frequently, better; and they save money by using less energy. Much of this casebook focuses on efficiency projects.

Energy efficiency is an effective economic development technique though, like import substitution, it is only one of several possible energy strategies that emerge from the Economic Renewal Program's "least-cost, end-use" approach to community energy.

Historically, most energy planning has dealt with getting more energy — more barrels of black goo, coulombs of electrons, or tons of compressed fossil swamp. This "supply-side" strategy frequently overlooks what the energy is used for — performing tasks such as heating and cooling homes, lighting dark spaces, running stereos, cooking meals, and powering vehicles. Examining what energy is used for is *end-use analysis*.

Tackling energy problems by finding the least expensive ways to provide needed services is called *end-use least-cost planning*.

Some communities draw up complex energy plans. They design grandiose efforts to replace energy sources and envision huge construction projects. They are frequently frustrated because their schemes don't come to fruition. They have overlooked the power of small individual actions. A small project here, a new system there, can add up to big savings. If, for example, Verdigré were to save just 10% of the money spent annually on energy, \$75,000 would remain in its citizens' pockets.

Many energy projects deal with saving BTUs (British Thermal Units, an energy unit — about equivalent to the heat in a kitchen match — used to describe the amount of energy used for heating or cooling) or kilowatt-hours (energy used at a rate of 1000 watts for a period of an hour). Instead, this casebook will focus on saving dollars and jobs. Examples will highlight actions by individuals, businesses, local governments, small municipal utilities, or a combination of all of these.

Some of the projects in this casebook use renewable energy sources such as solar, small-scale hydroelectric power, wind generation, and biomass. These are resources which, if properly managed, should last as long as the sun shines, rivers flow, wind blows, and plants grow. Developing these energy sources is most cost-effective when combined with efficiency measures. After all, trying to find new ways to keep a leaking bucket full is much more expensive than patching the bucket.

The Economic Renewal Principles

Economic Renewal is based on four principles: plug the leaks, support existing business, encourage new local enterprise, and recruit appropriate new businesses.

Plugging energy leaks and, therefore, keeping energy dollars in the community may include such efforts as community energy analysis and action plans, weatherization projects, import substitution programs, and local government or quasi-governmental programs for saving energy.

Supporting existing businesses can involve providing energy efficiency retrofits for individual businesses, undertaking utility and community load management programs, and building waste-based cogeneration. If some of these terms sound unfamiliar, don't worry; they will be explained in the case studies. Additionally, there is a glossary of energy terms at the end of this casebook.

The third principle explores how communities can encourage new energy-related businesses. The case-studies in this section focus on creating new businesses that provide energy efficiency services or renewable energy.

Structuring affordable incentives and using existing energy products and byproducts are examples of programs that will help recruit compatible new business, the fourth principle of Economic Renewal.

Many of the cases included in this casebook could be listed under several principles. This demonstrates how the principles work together. For example, a community that plugs the leaks and supports existing businesses is much more attractive to prospective new enterprises. As you read this material, don't worry about which category a project fits into; rather, consider whether it could strengthen *your* local economy.



Principle #1: Plug the Leaks

To prosper, a community must first stem the needless outflow of money. This section shows how communities have identified where dollars are leaking out, how to use energy more efficiently, and in some cases where an imported energy source can better be supplied locally — keeping both money and jobs at home.

This approach is not a call for isolationism. Very few communities can expect to produce all that they need. But cost-effective import replacement and a higher degree of self-reliance can enable a town to develop sustainable commerce and improve its ability to get through tough times. Weatherizing homes, setting up alternative transportation systems, and harnessing local energy sources does not isolate a community from other towns. Instead, it helps residents get enough money to buy cars from Detroit and mangos from Mexico. When less money is required for the necessities, more disposable income is created. The town also becomes more attractive to outside enterprises. Moreover, during economic hard times, a community that has plugged its leaks needs less

income for simple survival. Energy efficiency and better use of local energy sources makes a community more secure. For example, the benefits of good insulation are even more important during an oil embargo.

Plugging the Leaks is a strategy that people have used to keep energy dollars in the local economy. This principle is divided into four topics:

- community energy analyses and action plans,
- weatherization projects,
- import substitution, and
- local government and quasi-governmental programs.

Community Energy Analysis and Action Plans

In 1977, a group of citizens in Franklin County, Massachusetts, took a look at their energy situation.⁷ The poorest county in the state, Franklin County is an area of small farms and depressed mill towns with high unemployment. A citizen study group found that every household in this cold, cloudy area spent an average of \$1,340 a year to buy heating oil, electricity, and fuel for the family car. A total of twenty-three million dollars a year was leaving Franklin County. Holding up a bucket with a hole in it, one of the citizen analysts explained that this leakage of energy dollars was the same as the total payroll of the county's ten largest employers.

Under the most optimistic future forecast, by the year 2000 energy would cost a typical household \$5,300. To generate enough extra money in the county just to pay for household energy, the single largest employer — a Bendix plant — would have to duplicate itself every couple of years until the turn of the century. (The county's total energy import bill for all sectors was about \$48 million in 1975. By 1980, it had risen to \$108 million, of which \$42 million was just for households.) At an informal town meeting held to present the results of the study, the local utility and Chamber of Commerce were shocked. Presented in such terms, the future didn't seem possible.

The study group had, however, worked out what could be done instead: make buildings more heat-tight, use passive and active solar heat, run vehicles on methanol made from wood harvested sustainably from public woodlots, and meet electrical needs with wind or microhydro resources available within the county. Local machine shops, using unemployed workers, could make all the equipment. The program's cost would be the same as the amount that people in the county were then paying for household energy each year — about \$23 million. But the leaky bucket would be plugged. Money and jobs would stay in Franklin County.

Before the 1973 oil embargo, a dollar circulated in the county some 26 times before going outside

to buy imports; by 1977 it circulated fewer than 10 times. (Dollar recirculation refers to how many times a dollar is spent and respent within a community. Every time a dollar is respent in a community, a portion is retained locally. The economic multiplier is the sum of these portions.) Franklin County, the study concluded, was bleeding money. As a result of this analysis, the community developed a consensus that the only hope for economic regeneration was to stop the money drain by promoting local energy efficiency and self-reliant, renewable sources. As a result, what had been only a study on paper became the Franklin County Energy Project.

In a poll conducted in 1980, more than 90% of county residents said they had reduced their energy use since 1974; nearly one-half used, or planned to use, locally abundant wood for heating. Weatherization projects had cut home energy use in half in more than 200 homes and saved an average of \$560 each year in each home surveyed. Total energy use in the county did not grow during 1976-78.⁸

Once the energy problem was presented so that people could see it as *their* problem, not just a matter of convenience but of economic survival, they were motivated to start solving the problem on their own. As Ronald Reagan remarked in a nationally syndicated 1979 newspaper column, the study found that "...a carefully planned transition to renewable energy sources would not be difficult, would probably yield actual increases in the local standard of living and would cut back sharply on air and water pollution. I suspect quite a few communities across the country are going to undertake the kind of study that Franklin County pioneered. They can act in their own communities to take charge of their own future. That's a spirit worth bottling and spreading around."⁹

There is, however, another lesson to be learned from Franklin County. Although many people in the county are still seeking ways to save money on energy, the citizens' group disbanded long before accomplishing all of its goals. They chose a plan of action that required legislation by the state rather than one that depended primarily on local actions and decisions. Many members burned out chasing that elusive goal.

At the same time, the group lost its Department of Energy funding. (In contrast, some of the most successful cases in this book required neither state nor federal funds.) The group's leaders accepted jobs in other parts of the country, teaching others how to conduct similar studies. When concern about the energy crisis declined in the 1980s, the formal effort was reduced.

The Franklin County example provides three lessons: first, there are large energy opportunities at hand; second, economic development efforts should focus primarily on actions that can be taken locally; third, any economic development effort must continually be renewed. A community that makes the commitment to invest in itself must continue to do just that and to seek out new ways to plug the leaks.



In the late 1970s, Florida's Dade County undertook an ambitious plan to reduce the area's vulnerability to energy disruptions, reduce government costs, and increase the community's energy efficiency. Although implemented in a very large metropolitan area, the program generated a wealth of projects, some of which could be applied to rural communities. The county formed an Office of Energy Management to oversee the program efforts. Metro Dade's projects include emergency energy plans, facilities management, transportation, consumer

assistance, energy generation, and land use. The energy emergency plans focus on keeping the county running in the event of an oil embargo or similar event.

The facilities management program seeks to reduce energy costs for buildings and swimming pools. The county installed solar heating systems for swimming pools, fire stations, a tennis pro shop, and a boxing facility. Air conditioning is a major concern in South Florida. Just applying reflective films to windows reduces solar gain by 40%. Additionally, the county has a weatherization program for homeowners and retrofit services for commercial buildings. The county passed lighting codes for parking lots and landscaping ordinances to encourage planting trees for shade to cool buildings. The county instituted an electricity conservation plan in May of 1976 when high electrical prices presented county officials with three choices: raise taxes; cut services; or conserve energy and reduce costs. Since the first two options were politically unfeasible, the officials chose the third; and by 1980 the county reduced electric consumption by 12%.¹⁰ (Much larger savings are cost-effectively available from today's efficiency technologies.)

Transportation accounts for about a third of U.S. energy use. Metro Dade's transportation plans have included gas rationing, downsizing (buying smaller, more efficient cars for some county uses that don't need big ones), and a gasohol program for county vehicles. A number of programs have been undertaken to improve the county's overall transportation efficiency. These include a commuter club, exclusive bus and carpool lanes on major highways, a carpool parking program, a traffic control system that monitors traffic and resets traffic lights, and a bikeway network. The county has an extensive bus system and a rail system.

The county has ongoing programs such as regulation of gasoline price signs and advertising claims, a waste-burning electric power plant, cogeneration plants, a methane recovery system for a sewage treatment plant (all three of these technologies will be discussed in later cases), and land-use planning for the siting of transit stations and bikeways.¹¹ The county has

integrated efficiency criteria into its basic maintenance purchasing schedules and includes life-cycle costs in all energy-related purchasing. The energy office offered a loan program to help finance energy retrofits and efficiency measures for other parts of the county government. However, the other departments soon learned that the energy savings could be financially attractive enough for them to pay for the retrofits out of their own budgets. Some projects that are now getting underway include several large district cooling systems, which may also be cogenerators, and a large recycling effort tied to a new waste-burning plant.¹² Metro Dade's ongoing energy program demonstrates the many different directions community energy projects can take in an effort to save energy and money.

The city of Greensboro, North Carolina, found an interesting way to keep firefighters busy and increase public contact with city employees. The firefighters performed neighborhood energy surveys and offered house-by-house energy audits. The audits were performed by teams of three — two to knock on doors and talk with homeowners and one to remain with the truck to monitor fire calls. The audits took 45 minutes, and the firefighters were trained to answer questions about various energy retrofitting techniques and insulation methods. The firefighters' evaluation was sent to Duke Power, the local utility, for analysis. The auditors returned to the house in two to three weeks with the completed analysis, and to answer any other questions. The program was very successful. However, three elements could have been improved. First, the firefighters' visits were typically in the morning or early afternoon when many people are not home. Second, the analysis by Duke Power was based on estimates for standard buildings, as opposed to actual records for individual buildings, and therefore could be very different from the homeowners' actual bills. This created a little mistrust of the utility. Third, the program was only for homeowners, so the large renter population was not able to participate. However, despite these problems, the Greensboro project is a good model of a city-run audit program.¹³

On a smaller scale, Fremont, Nebraska, population 24,000, undertook an energy management program with help from the Nebraska Energy Office. An economic analysis of Fremont revealed an annual energy bill of \$45 million, of which \$36 million left Fremont. An energy plan was developed with goals to: "...diversify the economic base, support existing businesses, reduce waste in government operation, lower utility costs, and initiate employment opportunities."¹⁴ Following the plan, the city installed a more efficient lighting system, improved energy efficiency in operations and transit, and developed improvement plans and energy management systems for the schools and the Memorial Hospital. Fremont also established a revolving loan bank to underwrite homeowners' conservation measures.

Over two and a half years, Fremont spent about \$26 per person on energy programs. About half the money came from municipal appropriations and matching funds from the homeowner energy bank. The rest came from state and federal sources. The city is now saving \$95,700 in annual energy costs, giving the taxpayers a *15% annual return on investment*. An economist said that the "...program effectively substitutes efficiency, local labor, and local materials for energy previously imported from Canada, Wyoming, and Saudi Arabia."¹⁵



Effective energy planning does not require a large community. Osage, Iowa, population 3,800, is an outstanding example of what can happen when a community makes a commitment to energy efficiency. In 1974, the manager of Osage's municipal utilities studied the system's demand growth projections. Osage buys power from a cooperative in Wisconsin; however, this power can be "interrupted," so the utility must maintain enough generating capacity of its own in case power is cut off by the cooperative. At that time, Osage already had an overcapacity of electrical generating facilities. (Typically in the 1970's utilities in that situation would aggressively try to find new ways to sell the electricity.) Instead, Osage's manager questioned the assumption that electric use would continue to grow at 7% a year, meaning that in 10 years (1984) Osage would have to double its generating capacity — a rather expensive proposition. So the Osage municipal utility decided to try to limit energy growth to 3% annually which would delay the need for major expansion until near the turn of the century.

Osage was able to limit system demand growth to less than 3%. In fact, even with new customers coming online, it had no increased demand from 1976-1984.¹⁶ This was made possible through the efforts of the utility and the community to save energy. These efforts include:

1. Setting insulation specifications for all new gas or electric heat customers. It is estimated that 75% to 85% of all of Osage's homes are now well insulated. All new homes built in the last ten years have exceeded the specifications.
2. Using articles and ads in local media to emphasize the importance of conservation.
3. Issuing a bimonthly newsletter with news about efficiency techniques and local energy achievements.
4. Offering lectures on energy-saving methods such as insulation, reaching an estimated 20% of Osage's adult population.
5. Providing free use of an electric meter for customers who "just can't be using that much

electricity." The meter allows them to monitor the electrical use of a major appliance or a water heater, and has turned adversaries into friends.

6. In 1980, an infrared "Sky-Scan" was taken. It allowed people to see the roof heat loss from homes and businesses in Osage. Also, in just three days 250 computerized energy audits were completed.

7. In 1980, the utility, along with the local electric cooperative, bought a hand-held infrared scanner (\$11,000) for energy audits. Householders must be present to look through the scanner and see exactly where they are losing energy. With this free service, over 51% of Osage's homes and businesses have been audited (compared to 3% for the entire state of Iowa). One result is that 50% of all the electric and gas water heaters in Osage had extra insulation jackets installed. Subsequent promotions have raised installations to 95%. Insulation contractors have used the scanner to check for gaps in insulation and, since wet insulation conducts heat, the scanner has been used to find plumbing leaks.

8. The scanner is also used by the utility to check for loose or corroded electrical connections in the electric grid. This improves reliability and saves money by cutting power loss in the grid and by catching problems before a part fails.

9. In 1985, the utility contracted for a study that produced an infrared scan of two sides of every building connected to the system. The printed results were then interpreted for over 700 interested customers, allowing them to check the need for further weatherization.

10. Because the utility pays for all the street lighting in Osage, it has replaced all the incandescent, fluorescent, mercury vapor, and metal halide lamps with more attractive and more efficient high-pressure sodium lights. This paid for itself in 4½ years with electric costs at 5.2¢ / kW-h.

11. In 1983, the utility began an energy conservation program in the local schools. Included in the program are tours of the power

plant, discussions of how a utility works, and energy fairs where as many as 500 people came to see the students' projects.

12. In 1979, a voluntary load management program was started. Utilities typically experience a peak in demand on hot days when everyone is running air conditioners. To meet this added demand, utilities usually have two very expensive options: build extra generating capacity, or buy extra power from other generators. The Osage utility took a different approach. It asked customers to allow the utility to install devices that would turn off air-conditioner compressors for 7½ minutes of each half-hour during peak electrical demand periods (usually 3 to 4 hours) on the five to eight hottest days. Due to previous positive interaction with the utility and a little neighborhood peer pressure, 75% of those eligible voluntarily allowed installation of the load management devices. Several years later, part of this system was upgraded and people were offered either a free water-heater insulation jacket or two high-efficiency compact fluorescent light bulbs as an incentive to allow the changes. (These bulbs produce a warm, beautiful light, the equivalent of a 60-watt incandescent, but use only 15 watts of electricity. Additionally, these bulbs last 9 times longer than normal incandescents.) This time, 96% of everyone eligible responded to the program.

Osage was one of the first communities in the country to initiate a voluntary load management program. The utility estimates that the program has delayed the need for additional generating equipment until the mid-1990s and saved around \$200,000.

13. In 1983, local Jaycees weatherized the homes of lower-income families in the community. The \$9,000 for the project was donated by Northern Natural Gas. The Osage utility believes that "...it makes more sense to

permanently reduce the consumption of energy than to have federal, state, or local aid given each year to help people pay excessive bills."¹⁷

14. In 1987, the local Jaycees installed water-heater jackets, donated by the utility, for everyone receiving fuel assistance. In 1988, the utility offered free water-heater jackets to all its customers.

15. The utility established a conservation loan program for industrial customers to help them save energy and cut plant costs. The utility itself has undertaken cost-cutting measures and improved its own operating efficiency.

So, what are the results of all this? The utility has *cut its electric rates 19% and gas rates by 5.5% in the past five years*. By 1984, the utility was *free of debt*. (Since most utilities are always building to meet increasing demand, they are usually in heavy debt.) In 1985-87 the utility experienced the first demand growth since 1976, not due to a per-capita consumption increase but because Osage's three largest industries expanded, and new industry came to town. The utility estimates the conservation programs keep *\$1,200,000 a year* in the local economy.¹⁸ If a job is worth \$20,000 a year to a community, the utility figures it is keeping the equivalent of 60 jobs in the community,¹⁹ and Osage's population is just over 3,800. This is truly home-grown economic development.

A brief survey of Osage's economy by a St. John's University professor stated the town is very healthy, and has more businesses than usual for a small rural town. Almost all the storefronts on main street are filled, and they include three hardware stores, two grocery stores, and two thriving banks.²⁰ It is important to note that Osage's efforts have been successful because they are comprehensive, long term, and have wide community support.



Weatherization

In 1979, citizens in Calloway County, Missouri, undertook an energy study of their own. The volunteer group included a wide range of individuals and professionals from the community. The *Calloway County Energy Study* was published in 1981 and contained the following findings: \$35 million a year was spent on energy (this was more than the total income from all the crops and livestock in the county); saving just 20% of the energy used in buildings would keep at least \$5 million in the economy; only 7% of the people surveyed had ever taken part in an energy audit, but over 60% were interested in having one done. Out of this study grew the Calloway County Community Energy Project. This project was a six-week campaign starting in January of 1982 that included 18 weatherization workshops. The workshops were promoted through existing community organizations such as the Optimists Club, League of Women Voters, schools, and the Division of Family Services. The project created a cooperative weatherization buying club that saved workshop participants as much as 50% on the cost of weatherization materials. Additionally, the coop bought enough material with a \$600 grant to weatherize 40 seniors' and low-income homes. The weatherization was carried out by volunteers trained in the workshops.

Over 450 people participated in the brief campaign. It was successful because it involved a broad base of community leaders, local government, and community organizations. One of the key volunteers later said, "The cost of the campaign was \$3,600. Two grants, one for administration, the other for materials, paid for the entire program. We estimated the total savings to the community resulting from the campaign to be \$7,000 to \$15,000 for the first year, and at least \$40,000 over the lifetime of the conservation materials."²¹ Those are good results from a low-cost, very brief energy program. Additionally, project participants learned two lessons. First, timing is important — starting the project at the beginning of the heating season, say late September to early October, might have increased response.

Second, securing broad-based community support is a very effective way of stretching limited funds.

What exactly is involved in a weatherization program? Weatherization literally plugs the leaks. An average house built before 1977 has enough little holes and cracks that the heat loss due to air leaks is about the same as leaving a window open year around. Even just a few basic steps, like caulking around doors and windows, weatherstripping, and placing foam gaskets in switches and outlets can cut home energy bills significantly. Weatherization can also include window treatments like plastic films and adding roof insulation. Community weatherization projects can range from just a few homes, the ones on fuel assistance for example, to projects that involve thousands of homes.

In Massachusetts, the **Fitchburg Action to Conserve Energy (FACE)** created one of the best-known examples of mobilizing a community for rapid and extensive weatherization. FACE came about in 1979 because energy prices were rising rapidly and the community was dissatisfied with the meagre results of a federally-sponsored low-income home weatherization program.²² During FACE's three active months, 500 people volunteered time -- in some cases over 20 hours a week. The volunteers were trained to help their neighbors implement low-cost/no-cost efficiency improvements. Sixty percent of the city's 14,000 households were participants. Materials and salaries cost under \$20 per participating household. For each household directly participating, an additional one was eventually weatherized through word of mouth. Average energy savings were about 14% of monthly bills, or \$154.50 per household in the winter of 1979 alone.²³ At least 20 other communities have since used the techniques pioneered in Fitchburg.

In St Paul, Minnesota, several neighborhoods invented a way to save on the high cost of tools that might only be used once. A weatherization project established a tool library that by early 1984 had about 1,000 members. The **Tool Lending Library** has a \$3 membership fee and conducts workshops on home repair, weatherization, and tool use. The tools are

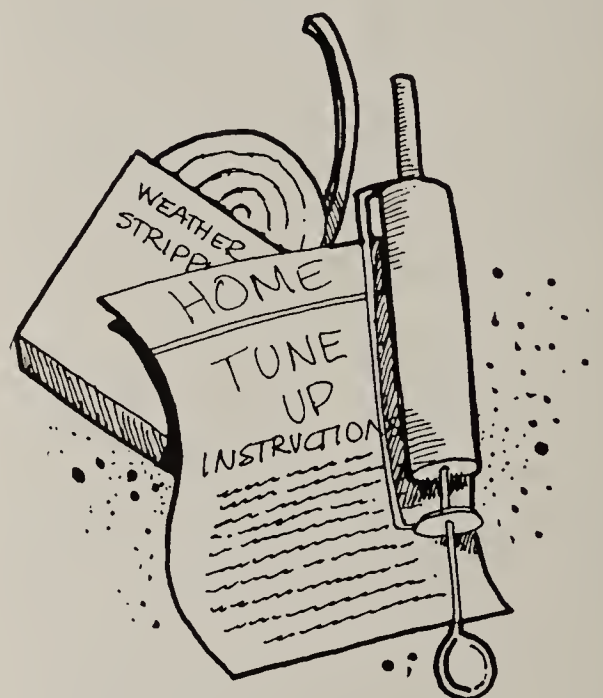
borrowed for home repairs, remodelling, retrofits, weatherization and conservation projects, and gardening. The project was started in neighborhoods and has gone city-wide. It is now housed in a public library. The Tool Lending Library publishes a newsletter, holds annual meetings, runs city-funded energy audits, and offers low-interest (5%) loans for alternative energy projects. The project was first attempted in 1978, but failed due to stolen tools, poor management, and trying to do too much too soon. When the project was restarted, several factors were important in making it successful, including: starting small (with a block or small neighborhood); joining with existing groups (such as a food coop); and using available skills in the community (such as skilled seniors). A representative of the project said that "the library does not compete with, but helps the private-sector hardware business by generating a demand for materials by freeing up household funds once spent for seldom-used tools."²⁴

An imaginative program was developed by **Citizens' Energy Corporation (CEC)** a public-interest, nonprofit company in Boston. Its primary business is to buy and distribute wholesale heating oil to low-income renters. It also implemented a program to help renters get their buildings fixed up. An agreement is reached between a landlord and CEC. Renters pay their energy bills to CEC. CEC pays the oil and utility companies, but also borrows money to make the buildings more efficient by insulating roofs, tuning up furnaces, and weatherization. CEC then uses the savings on renters' fuel bills to both repay its loans and give part of the savings directly to renters for low-cost/no-cost improvements of their own quarters. The result: buildings get fixed up, the bills go down, and nobody loses. The cost of fixing up the building is paid for by energy savings.²⁵

These are just a few examples of successful weatherization projects. Across the country there have been hundreds of good projects aimed at plugging energy leaks.

An important factor to remember about weatherization is that over the years the materials will wear out. Because materials must

be replaced, a weatherization project can be an ongoing community project. Also, community weatherization projects demonstrate how large cumulative savings can be achieved by small individual tasks.



Import Substitution

Import substitution is the replacement of an imported resource, such as natural gas, with a local resource, such as solar energy.

Sometimes communities do not have the time to undertake carefully planned programs of analysis and step-by-step implementation. Faced with a local energy crisis, they must improvise. In one instance, a dispute over prices in the late autumn of 1977 shut off the natural gas supply to **Crystal City, Texas**. Low incomes and the onset of winter forced townspeople to work with the materials at hand. They weatherized, installed mesquite stoves, and improvised solar water heaters costing \$85. Their actions were so effective that many are still using and expanding those "stopgap" measures, and increasing their energy independence.²⁶

An equally impressive case comes from the **San Luis Valley** in southern **Colorado** — a sunny but cold plateau, nearly as large as Delaware, at an elevation of 8,000 feet. The valley's traditional Hispanic community heated with firewood cut on what they thought was their commons-land from old Spanish land grants. In the late 1970s, a corporate landowner fenced the land and threatened to shoot people who tried to gather wood. The crisis was unexpected and immediate. Some of the people could not afford to buy wood or commercial fuel. But a few people in the community knew how to build very cheap solar greenhouses to attach to people's homes. Greenhouses capture sunlight to help warm the rest of the house. These greenhouses sprouted quickly, built with scrap materials and help of neighbors, like old-fashioned barn-raisings. In a few years, the San Luis Valley blossomed from four greenhouses to thousands of solar installations. Some are just solar collectors to keep the houses warm or to heat water. The greenhouses provide not only heat, they also extend the growing season from two or three months to year-round. This benefit greatly improves families' nutrition and cashflow. There are solar trailers, a solar post office, even a solar mortuary in the Valley. The Sears store and the Baskin-Robbins ice-cream parlor have installed commercial solar systems. Other renewable energy sources were used as well. Wind machines sprang up. Some farmers built an alcohol fuel plant fed with cull potatoes and barley washings, and powered by heat from a hot spring.

Spreading far beyond the original families who faced a cutoff of their wood supply, the household solar program remains an impressive achievement. Solar greenhouses are now being used to displace propane and electric heat. The cost of materials totaled \$4-5 million, bought mostly from local businesses over a period of several years. But organizers estimate the energy savings now add up to at least that much *every year*.²⁷ That's like the community having a bank account paying over 100% annual interest, *and* a secure energy source that cannot be cut off. The greenhouses also give the bonus of fresh tomatoes in February and sunspaces to sit in. The program keeps money and jobs in the community.

The same organizational techniques used to meet energy needs were then applied to another pressing need — health care. The organizers of the solar greenhouse program helped to save a local ambulance service and emergency clinic. They feel the issues are related, and point out that following the success of the solar program, people noticed a decline in such problems as alcoholism, stress, and family abuse. They feel that taking responsibility for solving their own problems has given the region a new sense of pride and self-confidence.²⁸

Additionally, the organizers set up their home as an energy demonstration center. For four years they ran the center as a Peace Corps rural training center in appropriate technology. The training center also became a focus for local community development projects.²⁹



A crisis is not always necessary for a community to consider import substitution. In 1981, **Willmar, Minnesota**, had an aging steam district heating system, connected to the municipal power station, that was losing as much steam as the customers were receiving. The town was faced with three options: abandon the system, replace it with a new steam system, or replace it with a hot water system. Additionally, the streets and sidewalks of downtown Willmar were scheduled to be torn up for major repairs and work on the underground electrical system.³⁰ The Municipal Utilities Commission chose to replace the system with a large hot-

water district heating system — the first of its kind in the country.

District heating has been used in European cities for many decades. First invented by Benjamin Franklin in 1748, the first successful commercial system was developed in this country in 1877.³¹ As fossil fuels became cheaper, popularity of these systems waned. If properly designed, they can save substantial amounts of energy. A district heating system usually is centered on one boiler. In many systems the boiler's steam is first used for electrical generation, although in some cases the boiler is just for heating. Heat from the boiler is transported to individual buildings through a network of insulated steam or hot-water pipes. One large heat-generating plant that operates on a fairly continual basis can be more efficient than many small ones in each building, each of which are turning on and off, heating up and cooling down. There is an extra boost in energy efficiency when the boiler is performing the double duty of providing heat for electrical generation (cogeneration). Most older district heating systems use steam; however, steam systems are plagued by pressure leaks, pockets of uneven temperature, and big heat losses. Also, steam is hotter than needed to heat most buildings. Hot-water district heating systems are not subject to pressure losses and the temperature-related problems of steam. These systems can be spread over larger areas as well.

Willmar chose to finance the \$2.1 million conversion and expansion through revenue-supported general obligation bonds.³² This meant that the system required *no federal or state funds*. The Willmar Housing and Redevelopment Authority offered five-year loans below the market rate to property owners who needed to remodel to convert to the district heating system. The cost of laying new pipes and expanding the system was built into the rate structure and into the financing bond. That made the average cost of joining the system less than \$100 for houses with forced air, and less than \$200 for houses with radiators. Another connection can be made for water heaters. Customers are metered and billed for the amount of the district's hot water they use.

The hot-water district heating system became operational in October 1982. At that time there were 125 connections to the sixty-year-old steam system. By 1988, there were over 400 connections to the hot-water district heating system. The 15 connections still using steam were in the process of being converted to hot water. And the system is expanding. Currently, 250 homes are connected, 150 businesses, a municipal hospital, three school buildings, some churches, and several government office buildings. When the system was first installed it was 20% cheaper than natural gas and much cheaper than electricity or oil. Since 1982 natural gas prices have dropped in Minnesota, so the system is currently just competitive with natural gas. But, over the long run, the district heating system will probably remain cheaper than individual heating. The Superintendent of District Heating for Willmar estimates that \$1 million a year that otherwise would have gone to a distant natural gas company now stays in Willmar.³³

As in Willmar, a district hot water heating system can be run off coal or other conventional fuels. It could also use alternative fuels such as trash or wood. In Scandinavia, a village has a district heating system powered by a large solar system.

But, no matter what kind of energy source is used, district heating is an example of import substitution. It can also put local people to work generating heat (and sometimes power) that had been imported.

Local Government Actions

Many community energy problems may not be entirely solved by individual actions or community mobilizations. There are several ways local governments and quasi-governmental programs can plug energy leaks in a community's economy. These include building codes, land use codes, community infrastructure, taxes, and licensing fees.

Building codes, zoning, subdivision controls, and land-use planning can significantly affect energy use. For example, a code can say how efficient a building must be, where gas and electric lines must be located, and how water and waste systems will be laid out. Solar access codes protect solar systems from being shaded by future development. Highways and shopping areas can be designed to limit driving distances. Each of these measures affects how energy is used now and in the future. New development that uses less energy, and gets it from renewable resources, provides a money-saving legacy for the next generation.

Among California cities and counties surveyed in 1981, energy-saving land-use policies were in place in 22% and pending in 28%; solar access in new subdivisions was protected in 24% and pending in 26%; and solar orientation was ensured by subdivision layout policies in 33% and pending in another 20%. The California Energy Commission has published handbooks on the preparation and adoption of solar access rules.³⁴ Some states have gone even further. New Mexico, for example, was the first state to protect a site's access to sunshine by state law. Oregon even protects existing sites' access to the wind.

Making energy codes part of building codes can guarantee that all new buildings will meet a minimum energy efficiency standard (though frequently not much better than the minimum). This automatically keeps money in the community which would have left if the buildings were poorly built. Building codes have also been used to improve the efficiency of older buildings.

Davis, California, developed and adopted one of the earliest local energy codes. The code was developed in 1975 with the active participation of many citizens. Local builders took part in an analysis that showed that any extra costs caused by the code would be paid back by energy savings within three years at 1975 energy prices. Together with land-use regulations requiring builders to consider energy needs of subdivisions and retrofit ordinances requiring older buildings to be fixed up, the code has cut Davis' total energy use in buildings by 30% since 1973, despite an increased population. Subsequent studies showed that the people of Davis support their code and have expanded and strengthened it.³⁵



Many older ordinances restrict or forbid — often unintentionally — energy-efficient building designs and passive solar measures. In Davis, for example, ordinances were changed to allow people to use clotheslines and to allow more flexible design of overhangs for summer shading. (It is ironic that many subdivisions have covenants that ban clotheslines, while many laundry products are advertised as making clothes feel and smell sun-dried or clothesline-fresh.) Davis and other communities have changed their codes to permit narrower streets. This reduces construction costs and saves energy for cooling by reducing the amount of hot asphalt absorbing and re-radiating summer heat. Other provisions encourage bicycle paths and lanes, facilitate the construction of earth-sheltered buildings, and encourage the planting of trees to reduce summer heat gain and shelter buildings from winter winds.³⁶

Partly due to the success of the Davis example, the California Energy Commission was able to gather enough support in 1978 to enact a statewide building standard for new houses. Compared to 1975 norms, "Title 24" cuts energy use in half. The code was revised in 1982 and again in 1984 to reduce energy use further in new homes. The standards are performance based; they set a performance level the building must achieve. Builders are free to achieve the goals in their own ways. The codes also provide several prescriptive options for achieving the necessary performance level in each of 16 different climatic zones, so that builders who do not want to do the calculations can just adopt a model "package."³⁷



While it is relatively easy to build new buildings requiring almost no energy to keep them comfortable year-round, it is more difficult to make all the existing buildings as energy efficient. Despite all the weatherization programs mentioned earlier, many people just don't want to bother. Therefore, many communities have passed retrofit ordinances requiring that old buildings be fixed up. In 1979, the City Council of **Portland, Oregon**, adopted a retrofit ordinance that should reduce the City's energy use by 30% by 1995. The law requires that houses sold after 1983 will be brought up to specific energy standards. In 1980, several

California communities passed similar requirements. **Eugene, Oregon**, followed in 1981 with an ordinance requiring all housing to achieve an energy standard by 1985. Compliance with the law is checked whenever there is a change in electrical service.³⁸ By September 1981, 12% of California's population lived in jurisdictions that had adopted or were considering retrofit ordinances. The California Energy Commission estimated that retrofits could save California households half a billion dollars per year.³⁹

Retrofit ordinances usually include such basic measures as increased attic insulation, caulking, weatherstripping, water-heater jackets, duct insulation, hot-water pipe insulation, shower flow restrictors (although these tend to be taken out because they produce a less-than-desirable shower) or low-flow showerheads (which save energy by saving hot water; some of the newer heads produce a 2-gallon-a-minute stream that looks and feels like a traditional 5- to 8-gallon flow), and sometimes window shading (to cut air-conditioning loads). These ordinances usually require that the prescribed improvements be made prior to resale, though some statutes require that the improvements must be made within ten years. Many of the laws require onsite inspection. Some ordinances place an upper limit on the amount people have to spend (for example, 1/2 to 1% of the house's sale price), so the retrofit costs will reflect the value of the property. Some, such as a state law in Minnesota and local ordinances in Madison, Wisconsin, and Boulder, Colorado, ensure that rental housing, which is often occupied by lower-income people with little control over improvements, will be fixed up within a specified period.

A community can also influence energy efficiency in buildings through the use of utility hook-up fees. **Hull, Massachusetts**, is a small blue-collar community south of Boston with an average of 25 new utility hookups per year. The municipal utility has a peak demand that occurs in the winter, and all of its electrical power is imported on two aging lines. Hull was discovered by luxury condominium developers in 1983 and suddenly faced the prospect of 2,000 new units within a few years' time. Already burdened with substantial debt due to its

participation in a wholesale power buying consortium tied to the Seabrook Nuclear Power Plant, the municipal utility could not afford the service upgrades needed to meet the demands of the new development. In 1985, with the support of existing customers and an activist utility board, the muni overcame developers' protests, instituted a ban on new installations of electric heat and hot water, and started charging hookup fees based on each customer's projected peak electrical demand. The fee is calculated on the basis of a flat square-footage charge plus additional charges for specific electric appliances such as a dishwasher, clothesdryer, range, or separate freezer. This is a penalty or "stick" approach.

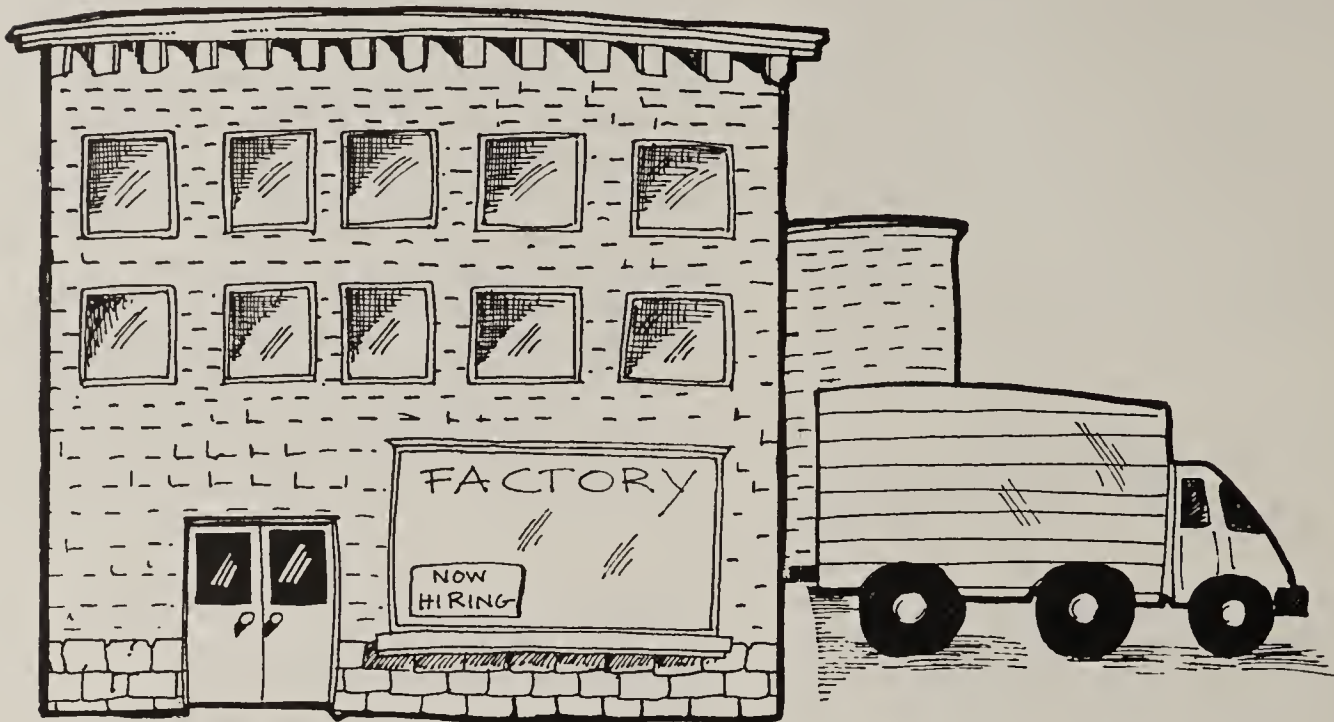
Although there is a publicized provision in the rules allowing the utility manager to reward very efficient construction with a reduced hookup fee, no builder has pursued this reward or "carrot." This lack of response may stem from market considerations. The utility manager noted that developers installed air conditioning in condos not because it is needed (coastal breezes keep the area quite temperate) but because some people buying a \$300,000+ condo expect it. It is a rare builder who will risk a sale that large in exchange for a few-hundred-dollar concession on a hookup fee.

The Hull fees have ranged from roughly \$600 to \$1,600 per hookup. With 2,000 condos initially planned, the municipal utility expected to collect about \$2 million in fees. As of May 1988 it had collected \$575,000. Hull has spent \$1.4 million upgrading its power system. Because building has slowed in Hull, the utility manager expects that existing ratepayers will wind up paying 20-25% of the upgrade costs, rather than 100% they would have paid without the fees.

In Hull's case, the municipal utility was more interested in providing funds for service upgrades than controlling electric demand growth; therefore, it has not pushed rewards for efficient construction.⁴⁰ In other cases there has been a balance between the carrot and stick approaches. In proposed statewide legislation, Massachusetts builders would pay higher hookup fees for inefficient buildings *and* be rewarded with cash rebates for efficient buildings — in effect, a *negative hookup fee* for efficiency. This sliding-scale fee program would not require the use of state funds because the inefficient builders would pay the rewards for the efficient ones.

There are other examples of energy-related ordinances and programs. **Richmond, British Columbia**, adopted zoning in 1980 that allows builders of multi-family developments to increase housing densities 10 to 15% if a certain fraction of the building uses renewable energy.⁴¹ Nearly four-fifths of California's communities are implementing bicycle path systems. Three-fifths are using dial-a-ride systems and synchronized traffic signals.⁴² Mixed zoning that allows people to walk to shopping districts and jobs, or raise food around buildings, or more readily work in their own homes (perhaps with computers), is also a popular way to reduce the use of energy for transportation. Changing development patterns to prevent community sprawl can reduce a community's energy needs by as much as half.⁴³

The examples in this section demonstrate how communities have plugged the energy leaks in their local economies. Energy action plans, weatherization programs, import substitution, and government programs are all effective techniques that can be applied to rural communities.



Principle #2: Support Existing Business

The second principle of Economic Renewal is to support a town's existing business. Most rural businesses employ fewer than twenty people, which leads many people to overlook their significance. But small businesses are the backbone of the American economy. Nationwide, two-thirds of all new jobs are created in firms of this size. Many development experts now believe that a community will succeed more quickly if it concentrates on encouraging *existing* local businesses to run more efficiently and to expand.

This section of the casebook explores how energy efficiency and developing waste-based energy resources can support existing business. Many of these projects are successful in supporting businesses because they increase net profit by decreasing expenses. Some of the examples in this section support businesses by turning waste into a resource. Some of the cases demonstrate ways to support just one business. Others are projects that help groups of businesses in a community.

Support Existing Business is divided into three topics:

- energy efficiency improvements;
- utility and community load management programs; and
- waste-based energy systems.

Energy Efficiency Improvements

Energy costs affect large and small businesses alike. In some cases they determine whether or not a company can stay in business. In the early 1980s, **Southwire Company**, a large manufacturer of copper rod, cable, and wire, was faced with spiralling energy costs. Its bills had increased from 10% of overhead in the 70s to 20%, and were increasing by 15 to 20% annually. In the highly competitive copper wire industry, profits are made on very slim margins, and Southwire's margins were rapidly declining. The company was forced to sell off assets and lay off 1,000 employees.

Southwire's management decided to commit resources to a daring (by industry standards) cost-cutting program focused on energy. Within the industry it was thought that they might be able to achieve a 20% savings, but the Southwire management set a goal of a 35% reduction in energy use.

Southwire has 4,000 employees in six continuously operating manufacturing facilities spread across the U.S. Its energy management team developed a number of strategies for saving energy at these sites. When motors burn out, they are not normally rewound; instead they are replaced with high-efficiency motors. Southwire stocks some motors onsite and has replacement supply agreements with motor manufacturers. Engineers check their operating systems and tag motors that are obviously oversized; when these burn out, they are replaced with correctly-sized motors. When plants are operating at low capacity the company will shift more operations to nighttime to take advantage of lower electric rates.

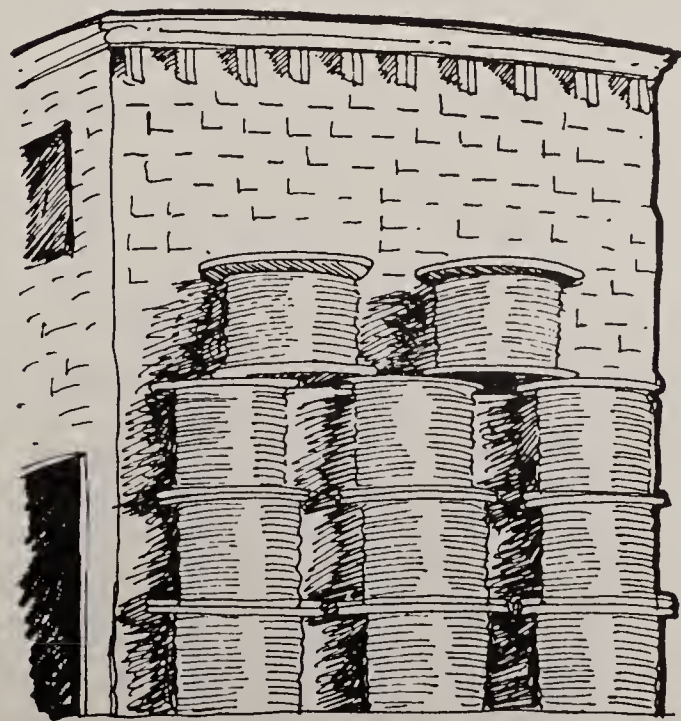
In one facility, the company was faced with very high electric bills for periods when the electric utility's demand was at peak. To save money, the energy manager recommended turning off equipment during these periods. However, because the plant was designed for continuous operation and employees are paid on a piece production scale (with profit sharing), the employees did not want to shut down. They argued that it cost \$50 an hour to turn off the machines. But, when the energy manager showed that during these peak periods operation of the machines cost \$200 an hour, they quickly agreed. Seventy machines are turned off by an in-plant computer. Southwire is now able to shed ten times the electrical load that it had originally predicted for peak periods. The next section of this casebook, *Load Management*, describes several programs to save money during peak periods.

Plant lighting has been another area of cost savings for Southwire. It has added many skylights to all six of its plants. Several buildings contained mercury vapor lights which, when installed ten to fifteen years earlier, had been fairly efficient. Since then, the lights had faded and parts of the plants were very dimly lit.

These 1,000-watt lights were replaced with 250 to 400-watt high-pressure sodium lights that saved substantial amounts of energy and provided better light. Efficient, longer-lived compact fluorescent bulbs were used to replace many incandescent lights when the energy manager determined that it cost around \$10 in maintenance time just to replace a bulb. The new bulbs saved money even before they were turned on.

Southwire has installed standby generators at several of its facilities and sells power to the local utilities during peak or down periods. One facility on a Connecticut river has installed a small hydroelectric generator which provides 60% of its power to Southwire and 40% to the local utility.

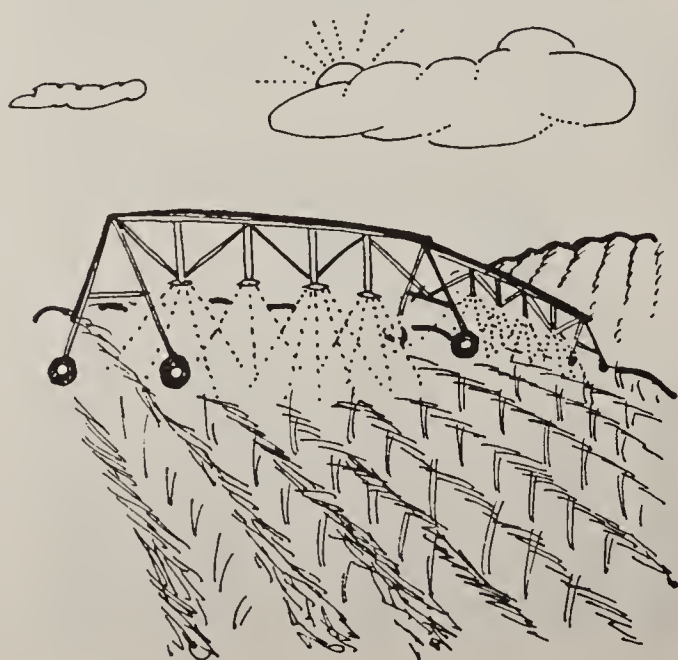
During the period from 1981 to 1988, Southwire was able to cut in half its energy use per pound of wire produced. Southwire estimates that it has saved \$40 million in energy costs, which have decreased from 20% of overhead to between 12½% and 13%. This cost saving through energy efficiency was financially equivalent to its profit margin when it was in trouble. Southwire's energy savings program turned around its profit margin and may well have saved the company.⁴⁴



In Hecla, South Dakota, the Jack & Jill grocery store was overheating in summer and using over 2,500 gallons of fuel oil to keep warm in winter. The 5,000 square-foot grocery/lockerplant/butcher shop was poorly insulated. Refrigeration compressors heated the basement up to 102°F in the summer.

Small rural grocery stores have a hard enough time competing with the big chains, even without huge energy bills. An electrician-refrigeration serviceman devised a way to lower the store's energy bills. During the summer, the heat from the basement would be vented outside; during the winter the heat could be used to help keep the store warm. Also, the store's 16-foot ceiling was lowered about four feet and insulation was added above it. For about \$2,000 a large blower was installed to duct the heated air from the basement to the retail floor. One of the owners said, "I remember thinking that we were making a big mistake, spending that kind of money. But, it was a really good investment. It has saved us a lot on heating costs."⁴⁵

The store had been using between 2,500 and 3,000 gallons of fuel oil a year to keep warm. With oil costing a \$1 a gallon, its fuel bill was between \$2,500 and \$3,000. After the efficiency measures were completed, the store's oil bill dropped to \$500. With this substantial saving, the project paid for itself in about a year.



Farmers near Yuma, Colorado, have been saving money by improving the efficiency of irrigation pumping systems. The existing systems are tested by U.S. Soil Conservation Service (SCS) Field Offices using pump test kits and manuals provided by the Western Area Power Administration. In some cases SCS recommends adjustments and minor repairs to pumps and different distribution methods. One area farmer reduced the horsepower on one of his pumps from 212 to 136, saving his tenant farmer between \$3,000 and \$4,000 annually. He said, "When you're looking at \$70-\$100 an acre in energy costs each year, it's a big factor in whether you stay in business or not."⁴⁶

One farmer near Burlington, Colorado, invested \$800 in changes to one of his pumps. He decreased the horsepower from 75 to 40, and changed his high-pressure center-pivot sprinklers to a low-pressure system. The sprinklers now hang 3-4 feet below the pipeline, which gets the water closer to the crops and reduces evaporation. The farmer also implemented several planting techniques that further reduced energy and water costs. He narrowed the distance between rows and adopted some no-tillage practices to reduce the use of tractors in the field (which saves diesel fuel and cuts down on soil compaction). All of these measures have led to more efficient water use in the fields. The farmer also reports that his corn yields have increased by 5-15 bushels an acre. Irrigation pumping costs that were running \$8,000 to \$8,600 annually were reduced by \$2,600 to \$2,800. Pumping costs have been decreased by one-third.⁴⁷

The operators of the United Grain Corp. elevator in Ord, Nebraska, found ways to reduce energy costs and curb grain spoilage at the same time. The elevator uses warm Indian Summer air pulled in by a large aeration fan at the bottom of the bin to dry grain with a moisture content of 20% or less. The naturally warm air does not crack the corn and therefore dramatically cuts down on spoilage. If conditions dictate using artificially heated air, it is recycled through the system to save 30% of the energy of a conventional dryer.⁴⁸ Machinery in each of the three legs of the elevator is used at different times to reduce electrical demand, and

the operators run equipment at off-peak times. All of these measures save the business money.

Improvements to lighting can also support businesses. Lighting usually accounts for a big portion of the energy cost of commercial buildings. Most commercial buildings are lit with inefficient overhead fluorescent lights. Additionally, to take away heat generated by inefficient lighting, many buildings have large air conditioning systems running year-round. There are a number of ways to improve lighting efficiency. They include: installing new high-efficiency electronic lamp ballasts (some of which also allow the lights to be dimmed, saving additional energy), using photoelectric-cell controllers that dim or brighten lights according to the amount of natural light available (most light systems burn at the same brightness whether it's noon or midnight), installing motion detectors that turn off the lights when a space is not occupied, using new polarizing lenses that reduce glare and give the perception of more light in a space, using new lamp phosphors that give more light and nicer color, and installing specially designed reflectors that increase the amount of light reflected down into the room (which in turn can halve the number of bulbs required to light a space). Installing new reflectors in the ceiling allowed half the fluorescent tubes to be removed from a Chicago commercial building. Thousands of lamps were removed, each of them representing around \$25 a year in saved energy and maintenance costs.⁴⁹ Using several of these retrofitting techniques together can produce even more dramatic savings — 75% or more — while providing the same amount of light and improving its appearance.

In Basalt, Colorado, the retrofitting of a bank's lighting system resulted in an annual operation and maintenance savings of \$2,148, with a 2.9 year payback. That's equivalent to a 34% return on investment. The lighting retrofit saves 22,952 kW-h annually and, if coal was burned to generate that electricity, 22,953 lbs of coal. By not burning the coal, 91,812 lbs of carbon dioxide emissions (a major contributor to global warming), and 597 lbs of sulfur dioxide emissions (a major contributor to acid rain) are avoided. [see endnote #65]

Iowa undertook a demonstration project to retrofit lighting systems in commercial buildings around the state. Funded by oil overcharge monies, the **Iowa Association of Municipal Utilities** chose 19 sites in 15 cities to demonstrate fluorescent lighting retrofits. The retrofits consisted mainly of changing ballasts and lamps in existing fixtures, and occurred in August and September of 1988. Retrofitted buildings included two banks, an elderly group home, a hardware store, a women's clothing store, a dime store, a fast food restaurant, a light plant, a hospital, a supermarket, a convenience shop, a grain and feed store, two city halls, three libraries, and the Association's Des Moines office.⁵⁰

The Iowa project demonstrated the wide range of businesses where lighting retrofits can be used to cut operating costs by improving energy efficiency.

Retrofitting lights, recycling heat, and changing pumping systems are just a few examples of how energy efficiency improvements can support existing businesses. As demonstrated in some of these cases, many of the improvements are rather simple. Many can pay for themselves in energy savings in a year or less.

Load Management Programs

Utility, business, and community load management programs reduce electric loads during peak periods by rescheduling, and voluntary and mechanical shut-off systems.

An electric utility must have access to sufficient generating capacity to fulfill peak demand in addition to base load, the amount of power used constantly by customers. Peaks generally occur during the hottest summer days when everyone's air conditioners are running, or on the coldest winter days in areas with many customers using electric heat. To meet peak demand, utilities must either build new generating capacity — which is not used at other times — or buy power from other utilities.

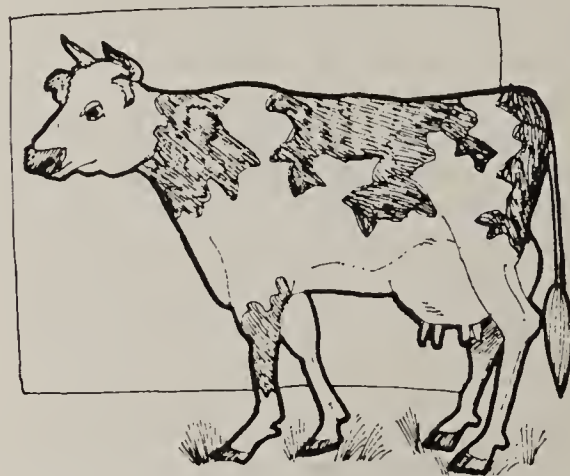
Either option can be quite expensive. In many cases the utility passes along this added expense by charging much higher rates during peak periods. Businesses and communities can save a significant amount of money by developing load management programs to reduce their usage or shift it to off-peak times.

Ten farmers with 17 irrigation systems between them, in the **James Valley Electric Coop** service area in **North Dakota**, are saving money by irrigating at night. The farmers who agree to irrigate only between 9:30 pm and 7:30 am are charged a special rate of 3.5¢ per kW-h and no extra demand charges. (The daytime demand charge is \$5.55 per kVA [kilovoltampere] of demand.) Night irrigation keeps the irrigation pumps' large load off the electric system during the afternoon peak use period. One farmer in the program estimates that he *cut his irrigation electric bill by 45% over previous years.*⁵¹ Night irrigation also results in less evaporation, which may mean less water and energy to pump the water are needed.

Near **Hondo, Texas**, irrigators have installed radio receivers and transmitters that can shut off pumps during peak use periods. The pumps are grouped according to size and the system is controlled by the local electric cooperative. When the utility is approaching a peak period it will shut off a few groups for up to three hours at a time. Participants in this "cycling" or "rotating blackout" system achieve lower electric bills through a reduced demand charge. In the program's first year, ten groups joined the system. Seven were cycled off 12 times and three of the groups were cycled off 13 times. The first year of operation saved the local utility about \$160,000.⁵²

Load management systems can be very simple. In **Shickley, Nebraska**, a yellow light is lit on Main Street when the town is approaching a peak electrical use period. The light is mounted on a pole in front of the bank in this town of 420 people. From this position, the light can be seen along the four-block central business district and in most residential areas. The light is controlled by a preset meter at the City maintenance building. When it comes on, many people shut off air conditioners (which account for about 60% of the load), the city switches to auxiliary

power for its pumps and sewer equipment, and the grain elevator shuts down its drying equipment for three to four hours.⁵³ Other towns in **Nebraska** use the air raid siren to announce their system is nearing peak and it's time to shed electrical load. Still others simply phone their biggest customers and ask them to cut back operations briefly. The success of these programs varies from town to town and seems to depend on the relationship between the town government and its citizens. As mentioned in a previous section, citizens of **Osage, Iowa**, installed 610 mechanical devices that shut off air conditioners and water heaters for brief periods during peak electrical use.⁵⁴



Waste-Based Energy Systems

Virtually all businesses produce some waste. Sometimes a waste can become a business asset. This section includes projects that use agricultural waste (such as manure) or industrial waste (such as wood chips) to produce heat or electricity. Also covered in this section are municipal solid waste (trash) burning systems. Using nontoxic waste energy systems can help businesses cut dumping fees and save on energy costs.

The **Arizona Dairy** in **Higley, Arizona**, is a large operation with 4,500 Holstein milking cows that produce about 90,000 gallons of slurry effluent, a mixture of manure and water. Slurry is put into digesters to produce methane gas. This gas powers a cogeneration system that can produce as much as 50% or more of the dairy's electrical needs. Heat from the generation system is then used to heat water for such things as equipment sterilization. The generators may run for 21 to

22 hours a day.⁵⁵ In some slurry digester systems, additional income is generated by selling the leftover material from the digester as fertilizer.

How much can be squeezed out of such a system? A dairy farm in Pennsylvania uses an anaerobic digester to convert manure to an improved fertilizer and methane gas. The methane runs a diesel generator which powers the farm. The generator's waste heat makes hot water to wash the milking equipment, saving more fuel. Waste heat recovered from the washwater is used to preheat the cows' drinking water, increasing their milk yield. Dried residue from the digester, whose heat kills germs, is used as bedding for the cows. The cleaner bedding saves money by reducing mastitis, a disease of cows. In addition, if waste heat from the bulk milk chiller (a giant refrigerator) is used to heat the digester during the winter, then a forty-cow dairy might become a net exporter of both milk and energy.⁵⁶

Methane digesters are typically used in wastewater treatment plants to stabilize sludge and capture energy at the same time. A digester is, in effect, a large sealed tank in which waste decomposes anaerobically — without oxygen. In many instances, however, methane is just a smelly byproduct of the system. A system at the treatment plant in **Sioux Center, Iowa**, has a large insulated floating steel cover that keeps air out of the tank. As gas is produced by decomposition (about 60 to 70% of which is methane), the cover rises. The cover produces sufficient pressure to force the gas through a pipe to a gas engine blower in another building. This gas engine replaces two 50 horsepower electric blowers that run air-driven rotating disks used as a part of the treatment process. During the winter, much of the methane is used to warm the digesters, but during the summer it can be used to run the engine for as much as six hours a day. The plant was also designed with several other energy-saving features: it has few windows, is superinsulated (superinsulation will be explained later), and has earth berming around the various buildings. When asked about the methane energy system, the Head Plant Operator says, "I would recommend it if anybody is looking for a way to save electricity."⁵⁷

A potential energy export, methane can be harvested from landfills. For example, the city of **Modesto, California**, uses methane from its sewage plant to fuel its car fleet. Modesto's pilot system went on line in 1978 and by 1984, 200 methane-fueled city vehicles were using methane equivalent to 1,100 gallons of gasoline a day. (The car fleet can also burn gasoline, providing resilience should the methane system go down.) Surplus methane is also used to fire boilers at the city hall and police station.

The Modesto system includes scrubbers to remove the hydrogen sulfide and carbon dioxide from the sewage gas. This process can be very expensive. However, Modesto found a way to use water for scrubbing, and thus save money. The Modesto system was expected to pay for itself in about seven years, but lower oil prices lengthened the actual payback period slightly. City officials noted that the system would have paid off more quickly if they hadn't had to install 3½ miles of 2" steel pipe from the conversion facility to the vehicle depots. Besides saving gasoline, the methane system has other advantages. According to a spokesman for the plant builder, it burns so cleanly that "...you can breathe the exhaust" (though we don't recommend this practice). Also, because methane is already a gas, "...engines start easier and your engine lasts longer." The success of the Modesto system has led Hagerstown, Maryland; Livermore, California; and other communities to build similar systems.⁵⁸

Other wastes are also used for fuel. In **Stockton, California**, a walnut-packing plant uses walnut shells to produce steam and electricity for the plant. A cannery in California uses peach pits as its fuel source. It is estimated that the U.S. forest products industry gets as much as 60% of its energy from wood wastes.

Fuel for some businesses has come from the pallets, cardboard boxes, and similar shipping materials that would otherwise wind up filling the dumpster at the receiving dock. Dordt College, in Iowa, uses egg cartons, shipping boxes, and other cardboard waste from local meat packing and poultry operations to fire three boilers that provide steam and hot water to the campus. A small local company, named E-Z Fuels, shreds the materials and then runs them through a "Lundell densifier machine" which produces compressed pellets about 3/4" in diameter. The pellets are fed into the burner system which operates at 2,500°F and heats the 357,900 square feet of the college's 12 buildings.

Originally, the campus' boilers were fired with natural gas. Now the campus uses the pellets to fire its base load boiler and the other two that are primarily used during the 7:00 am - 9:00 am peak-use period. Because it is a demonstration project, the system has been subjected to strict environmental monitoring. The local superintendent of utilities said, "To date, it appears the fuel produces no visible pollutants, [and] burns so thoroughly it needs no electrostatic precipitators or baghouse..." What little ash residue produced is used by local gardeners as compost.⁵⁹ (Ash from trash-burning systems should be analyzed for dioxins from bleach before it is used for compost.)

In 1971, Ames, Iowa, had a landfill that was projected to be full in five years. After a task force considered several options, the city decided to modify the existing municipal power plant to burn local trash. Prior to burning, however, the city would recover as much of the recycleable materials as feasible. The Ames Resource Recovery Center has been operating for 13 years, processing 150 tons of refuse a day. Using an elaborate system of separators and grinders, glass, aluminum, oil, paper, ferrous metals, and wood chips are removed from the refuse. *The system recycles 93% of the solid wastes.* The burnable refuse is then mixed with coal at the power plant. The municipal power

plant can handle a fuel mixture of up to 20% trash, though it normally operates at a 10 to 15% trash level.⁶⁰

To ensure a steady supply of refuse, the Center has signed trash contracts with surrounding towns. These towns supply a portion of the trash used in the Ames system. Most of the plant's income is derived from the fuel that it sells to an adjacent power plant; additional income is derived from dumping fees and the sale of material to recycling companies. The plant frequently operates at a loss. However, the City of Ames considers the plant a success since it meets its basic goal — to reduce the flow of material into the municipal dump.⁶¹

Americans tend to keep waste "out of mind" by stashing it "out of sight." When we dump or bury some 450,000 tons of trash each day, we squander a useful resource. Trash is a resource out of place. If burned it could meet a portion of our energy needs.

In 1986, there were 46 waste-to-energy plants operating in the U.S. and another 36 were under construction. Though these facilities contribute to the local energy supply, they can cause serious problems. Some systems produce toxic smoke and create huge piles of equally toxic ash which then must be disposed of. Burning everything (sometimes called mass burn) in the dump also means that recyclable materials, and the income they could generate, are lost. And big investments in incinerators can get communities "hooked" on making lots of trash. [see endnote #61 for additional information]

Energy projects are important means to strengthen the backbone of your community's economy — its existing businesses. A community can support its businesses through energy efficiency, load management programs, and waste-based energy systems. By reducing business expenses and, therefore, increasing after-tax income, energy savings go straight to the bottom line.



Principle #3: Encourage New Local Enterprise

Older businesses are replaced by new ones in any dynamic economy. This process is usually unnoticed until business failures outnumber startups. However, there is much a community can do to tip the balance toward success. A community should seek to set up new businesses that build on local strength. Efforts should be tailored to make best use of the existing labor force, infrastructure, and resources. A town should emphasize businesses whose size and character are appropriate to the existing economy. This section is devoted to exploring how communities can encourage new energy-related businesses.

This casebook addresses four energy-related topics that can help *Encourage New Local Enterprise*: The four topics involve creating new businesses that provide:

- energy-efficiency services,
- end-use services,

- new energy sources from sustainable local resources, and
- an interesting twist on business incubators, an "energy projects incubator."

Efficiency Services

Several new types of businesses have been created to sell or produce energy-efficiency systems. Energy efficiency can be sold by such direct means as hardware sales or may involve creative financing options such as shared savings.

In a shared-savings program, typically the company that installs the equipment pays for the equipment and its installation (and sometimes for its operation, maintenance, and management). The shared-savings company makes

money by keeping a share (usually 50 to 90%) of the energy costs saved for a specified number of years (usually 2 to 5). The customer may pay nothing up front, *and* his or her energy bills go down. After an agreed upon period of time the equipment may become the property of the business or institution where it was installed. It then receives the full benefit of the energy savings. A business that contracts for this type of installation may, for example, take three years to pay off the system. Payments for the first two years pay for the system. Third-year payments are profit for the efficiency service company. Shared savings is one of several creative ways to finance large energy projects. Performance contracts (which may involve a guarantee to save *X%* of energy, by whatever means), leases, and installment sales are some of the financial instruments used in the implementation of energy efficiency.

Energy efficiency service companies sell hardware and software systems to businesses, residential complexes, and institutions. Some of these energy firms focus exclusively on electric or gas efficiency, while others offer a wide range of efficiency measures, including water-efficient appliances. Typically the company will first perform an energy audit, then recommend ways to save energy. A number of energy efficiency service companies have sprung up around the country over the past few years. Some are even unregulated subsidiaries of utility holding companies. A utility that provides energy efficiency can generate profit by: financing the energy savings projects, saving operating costs (by burning less fuel), deferring costly construction, and marketing its energy efficiency-services to other utilities. Some utilities have successfully marketed their energy-efficiency services in the home areas of other, less enterprising, utilities.

Additionally, some energy services may save energy of a competing type. Gas companies may sell electric efficiency or vice-versa. Consider,

for example, a office building which is gas heated but electrically lit and cooled. The gas company could arrange and finance a lighting retrofit. This cuts the customer's electric bill. The gas company temporarily raises the gas bill to cover the cost of the retrofit. But the customer's *total* bill is still less than it was. This gives the gas company a highly lucrative financial product: it can achieve, say, a two-year payback, bill the customer for a three-year payback, and pocket the difference. Office operators consider the year's foregone return a small price to pay for permanently lowered bills and improved visual and thermal comfort — none of which required more effort than entering into an agreement with the gas company. Because less heat is generated by the more efficient lighting, the gas company may also be able to sell a little more gas for space heating.⁶² Later, the gas company may be able to sell a gas chiller or packaged cogeneration unit; both will be more cost-effective after the lighting retrofit than before.

FPL Energy Services, a subsidiary of the holding group that owns Florida Power & Light, is marketing energy-efficiency packages to commercial and institutional customers in Florida. Since beginning operations in 1986, the firm has initiated over 20 projects, reducing energy use in more than 70 buildings by an average of 10 to 15%. The financing packages are tailored to the customers' needs. Some involve performance contracting in which FPL installs equipment at no charge and takes a share of the savings as payment. Other deals involve leasing or financing the equipment over time.⁶³

Puget Energy Services, a subsidiary of Puget Sound Power & Light, has been providing turn-key energy-efficiency services through performance contracts, installment sales, and lease/purchases for the past few years. Based in Bellevue, Washington, the firm operates throughout the United States with offices in Boston, Philadelphia, and San Francisco. In June 1988, the firm had about two dozen projects completed or underway in seven states, with a total value of about \$3 million and reporting typical energy savings of about 10 to 20%.⁶⁴

The small mountain town of Basalt, Colorado, is the home of **Rising Sun Enterprises**. This young company, with a staff of four, sells and installs energy- and water-efficient technologies. About 75% of their work involves recommending and supplying efficient commercial lighting systems. The rest is split between water-efficient technologies and independent energy systems (stand-alone photovoltaic systems). Rising Sun is one of the largest suppliers of direct current lighting systems in the country and has recently started a mail-order catalogue for energy- and water-efficient hardware.⁶⁵

A Saint Louis business superinsulates old brownstone houses. Superinsulation is the process of plugging the leaks in a building's structure to minimize heating and cooling costs. A superinsulated building typically has double the standard amount of insulation in the walls and attic. The foundation is also well insulated. Additionally, the structure has very few cracks and holes leaking air. To maintain indoor air quality, these buildings usually have air-to-air heat exchangers which, in winter, take heat from warm exhaust air and use it to warm incoming air. In the summer the process is reversed. A superinsulated structure is so efficient that it gets much of its heat from people, pets, lights, and appliances in the building.

Rehabilitating an old brownstone can produce dramatic savings. Following superinsulation a home that would have cost over \$800 a year to heat and \$250 to cool at 1983 prices, now has \$66 heating bills and \$73 cooling bills. As a bonus, it's more comfortable, thanks to even temperatures and no drafts. Superinsulation adds \$3,500 to an ordinary remodel, or about \$35 a month on a 30-year, 13% mortgage. However, the energy savings are twice as big, amounting to \$79 per month. This means that the new owner has a \$44-a-month or \$528-a-year increase in cashflow. The home is protected from moderate future energy price increases. Another bonus; it is worth more at resale. Typically, if local realtors and buyers are informed — for example, by efficiency ratings or labels on the houses — retrofits can increase resale value by 10 to 25 years' worth of energy savings, or about \$9,000 to \$20,000.



In some places it is easier to finance an energy-efficient house. Some bank programs accept lower income thresholds for various mortgage packages when they are tied to an energy-efficient house. Resourceful bankers realize that if you have stable and unusually low energy bills, you can afford slightly higher monthly payments. For example, in 1984, federal Fannie Mae guidelines were revised to allow energy-efficient home buyers to spend up to 30% of their monthly income on mortgage payments instead of the usual 28% limit. To meet the criteria, the house must receive its energy-efficient rating from an appraiser or meet the National Association of Home Builders' guidelines. A Denver bank set lower income requirements for buyers in a subdivision where the builder estimated that the yearly heating bill for his somewhat more energy-efficient homes will average \$479, compared to \$1,300 for a similar inefficient one.⁶⁶

Energy Rated Homes (ERH) of Burlington, Vermont, certifies appraisers and produces energy ratings for homes. The homes are awarded one to five stars and homeowners are given a list of possible improvements to increase the house's rating. A home that receives a high rating may qualify its buyer for a bigger mortgage through a program ERH calls the **Energy Efficient Mortgage** (which is supported

by Freddie Mac and Fannie Mae). ERH is a part of a group of sister organizations that are expanding nationally.

The ERH program can also be used to mortgage energy improvements in a new home. In West Enosburg, Vermont, a young couple was preparing to buy their first home. The house had a "one star" energy rating. They tightened up and insulated the little house. In addition, they upgraded the water heater and the heating system. These changes were estimated to save 38% of the yearly heating bill. As a result of their improvements, the house received a "four star" rating. The couple was then able to finance the house and improvements at a local bank with an "Energy Efficient Mortgage."⁶⁷

By guaranteeing annual electric heating bills that would not exceed \$100, a builder in cold Butte, Montana, captured 60% of a four-county housing market in three years by producing simple superinsulated houses. He had to deliver on the guarantee only twice — once for \$3 and once for \$17. (In the latter case, the builder suspected that the occupants might have left the door open in mid-winter.) The builder's business grew to serve a market 500 miles in radius and developed a long waiting list.

Another builder of superinsulated houses guaranteed that for the first few years of occupancy, he would pay any annual heating bill that exceeded \$50. Few homes sold because no one believed that a house could be kept warm so cheaply. So he changed his offer and said that he would pay for any bill over \$100. His homes began selling rapidly.⁶⁸

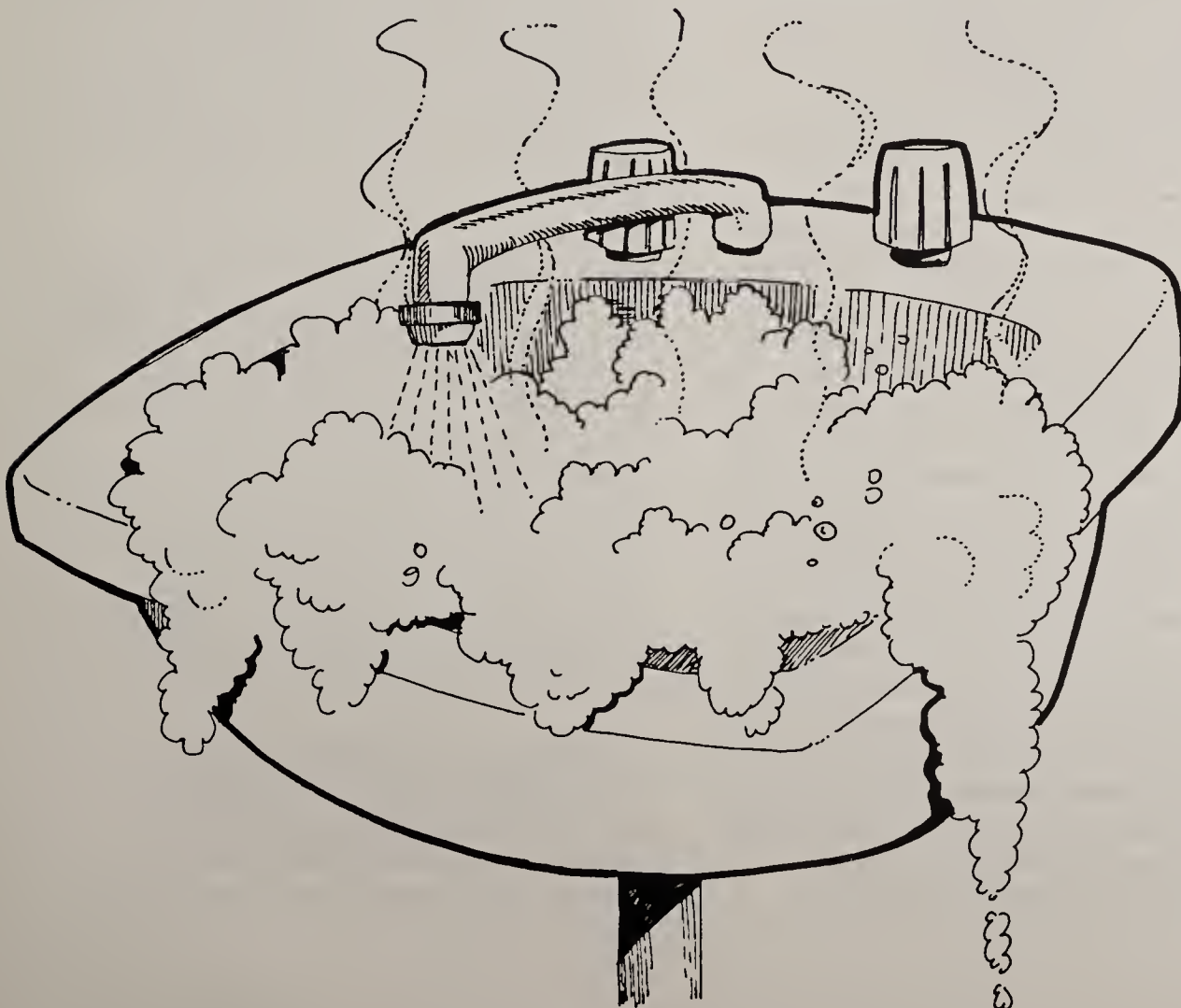
End-Use Services

An end-use service is what Thomas Edison had in mind when he created the first utility. He did not sell kilowatt-hours (kW-h). Rather, he sold light, charging one cent for every hour a bulb was on. In the 1880s, most cities had compressed air utilities to drive motors. But as electric motors started to become popular, New York Edison Company wanted to stop selling light and start selling kW-h to serve lights at night and motors mainly in the daytime. Edison thought that was a stupid idea. Customers, he said, wanted and understood light, not electricity. He also knew that more efficient bulbs would be invented. He reasoned that vendors of lighting services would then make more money because the cost of lighting each bulb would decline. On the other hand, vendors of electricity would simply sell less and lose profits to the light-bulb manufacturers. He was overruled in 1892, and most utilities today still see themselves just as providers of gas or electricity, rather than of heat, light, or shaft power.

But this is beginning to change as some utilities realize that energy is just a means to provide comfort, light, or shaft power. End-use service companies package technologies to provide their customers with light, heat, cooling or motor drivepower. Packaged, fixed-fee energy services are starting to catch on in the U.S., following Europe's lead. Much of the commercial and residential space-heating in France, for example, has long been provided by *chauffagistes* who maintain a given floor area within a given temperature range for a fixed fee, typically about 15% below normal oil-heating bills. How they do it is their business. If they can provide heat more cheaply by insulating the building than by consuming fuel, they are free to do so and then pocket the savings. Naturally, there is keen competition among *chauffagistes* with better ideas about providing least-cost space-heating (and often hot water). Around 11,000 of these energy-service companies now operate profitably in Europe. Some are over 40 years old. New companies called *illuminagistes* are also beginning to provide the same type of service for lighting.⁶⁹

An extensive potential for businesses that provide end-use services exists in the US. For instance, although Humboldt County, California, has extensive solar, hydroelectric, and wind resources, it imports 80-85% of its energy.⁷⁰ The **Humboldt Solar Utility (HSU)** provided an essential end-use service — hot water for homes. HSU leased and installed solar collectors and equipment on homes, businesses, and apartment complexes, then billed customers for service provided. HSU was initially funded through tax-sheltered investments, some federal funds, and income from operations. The project was developed by Humboldt's Redwood Community Action Agency as a way to save local energy dollars, provide job training, and create new private sector jobs. By 1985, 50 single-family residences were part of the solar utility, and 200 apartments were scheduled for solar installations. HSU was set up to also expand into weatherization and cogeneration and to explore various commercial and industrial energy projects.⁷¹

In 1981, **Oceanside, California**, began leasing solar systems to residents through its **Municipal Solar and Conservation Utility**. The customers paid a small deposit. City-approved dealers owned and maintained the systems. Fifty-five percent of the customers' municipal utility bills qualified for the state solar tax credit which was available for privately purchased equipment or for equipment leased through a municipal solar utility. The program received \$20 million in start-up capital — perhaps the nation's largest concentration of capital for solar installations. The leasing companies raised the money by marketing investment packages. The city charged a 10% fee on the companies' gross revenues. After the first thousand installations, the program was expected to generate a profit for the city.⁷² However, this program and the one in Humboldt ended in 1986 when the tax code was changed to eliminate solar subsidies. It is unfortunate that these systems were dependent on tax credits. But the concept of a municipal solar utility (MSU) is still a good one. Several dozen California cities created similar local utilities specifically to promote efficiency and solar energy.



Renewable Local Energy Resources

Another opportunity for new local enterprise is the development of new energy sources from renewable local resources such as solar, hydro, wind, and biomass. If properly managed, these resources are sustainable. That is, they should theoretically last as long as the sun shines, rivers flow, wind blows, and plants grow.

So far, the examples in this casebook have focused on energy efficiency, which is the most cost-effective way to cut energy bills and keep more money in the community. Chasing after renewable energy sources without first using energy-efficiency measures is like trying to find new ways to fill your bathtub with hot water while forgetting to plug the drain. However, renewables and efficiency together can compete with many fossil fuel systems, and once you have saved as much energy as practical, the next best way to increase self-reliance is to develop local renewable energy sources.

Renewable energy already provides a tenth of our nation's total energy.⁷³ Wood alone provides almost twice as much *delivered* energy as nuclear power.⁷⁴ Chris Flavin, a senior researcher at the Worldwatch Institute in Washington, D.C., noted, "The most important advances made in renewable energy are not yet visible on the national energy charts, but they soon will be." He and many other experts say it would not be difficult for renewables to meet 20% of our energy needs by 2000.

Energy use and production is sometimes discussed in terms of "quads." A quad is one quadrillion BTUs, a very large amount of energy. In 1987 the U.S. consumed about 76 quads.⁷⁵ (Adding several quads of uncounted renewables brings the total to about 80 quads.) The American Council for an Energy Efficient Economy estimates that if our national economy was using energy at the same efficiency level as it did 1973, then we would have consumed 107 quads in 1987. Since 1973 efficiency has become a far bigger source of "new" energy in our economy than all expansions of fossil fuels. In fact, since 1979 the U.S. has "generated" more than seven times as much new energy from savings as from all net expansions of energy

supplies combined. Of these expansions, more were from renewable sources than from nonrenewables. In 1980, renewable energy and efficiency in America was a \$15 billion business.



Hydropower

Using dams to provide power is an ancient technology, one of the first used to produce electricity. It is also the second-largest source (after wood) of the renewable energy we use today. Hydropower provides 13% of U.S. electricity. Studies have identified the potential to produce an additional 47,000 megawatts (million watts) of electricity. (That's as much as 47 large nuclear or coal-fired power plants.) About 20,000 megawatts could be produced at existing dams, mainly by filling empty turbine bays and upgrading obsolete turbines and generators, or by rebuilding dams that have fallen into disrepair. Over the past few years more than 4,000 new projects were proposed to the federal agency that regulates hydro projects. If all of these were completed, they would generate over 16,000 megawatts of hydro power. Many of these projects, though, are not appropriate. Many would flood farms, dry up scenic rivers, ruin rafting, disrupt fisheries, or otherwise harm local economies. Many are simply uneconomic for a number of reasons. However, for many communities, small-scale hydro, thoughtfully designed on appropriate sites, makes a lot of sense.

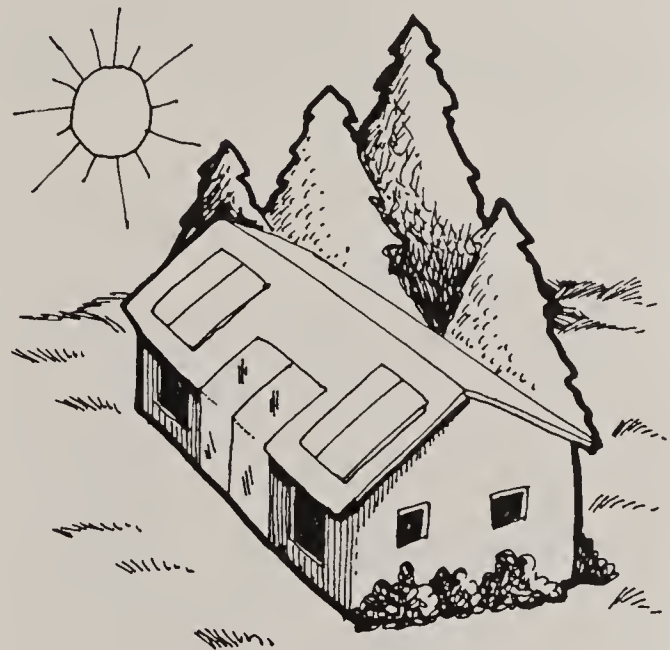
Sensible hydro development can come in a variety of sizes. Very small hydro is called microhydro. Small hydro facilities can be economical for generating even just a few kilowatts. Some systems do not require dams.

They rely on a small pipeline that runs along a stream with a fairly good drop in elevation, or a floating raft with paddle wheels turned by river current to power a generator, or on a device using a series of slats strung on a sort of rope ladder on pulleys.

The water supply for **Boulder, Colorado**, is located near the Continental Divide. The water is piped down to a water treatment plant above the city and then piped from there down to Boulder. There is a substantial elevation drop through the system, and the pipelines contain several pressure-reducing stations. The city installed six hydroelectric generating facilities, many of them located at the existing pressure stations in the system. According to the city's Energy Office, the largest of the six produces electricity "...equal to the amount used by 1,500 families annually, and requires no fuel and causes no pollution." Describing the reasoning behind the project, the Energy Office said, "It is hoped that these small plants, combined with other efficiency and renewable energy projects, will help delay the need for a new expensive, coal-fired plant on the Public Service [Company of Colorado] system. This not only keeps the cost of energy from rising so fast, but also keeps energy revenues within the local economy and provides a new source of municipal revenue to keep water costs down and to reinvest in other pressing local needs."⁷⁶

Some communities have old dams that were built for purposes other than generation of electricity. The **Old Burlington Dam** in Carolene, North Carolina, is now being used to generate electricity. Rather than rebuilding the dam — to install penstocks and put turbines underneath — a large siphon tube was installed over the top of the dam creating a head of 20', and turbines were installed in the flow of the siphon. While siphon systems have been used for years in Europe, the Old Burlington Dam Project, which became operational in August 1985, is the first of its kind in the U.S. A private partnership financed and developed the 288-kilowatt project. A representative of the turbine manufacturer said, "A siphon makes it possible to develop a site at low cost without structural modification of the dam."⁷⁷

Sometimes an existing hydroelectric dam can serve a new economic purpose. In Massachusetts a hydroelectric dam is being turned into a tourist attraction. Each year over one million shad, salmon, and black herring migrate up the Connecticut River and through the fish elevators on the **Holyoke Dam**. The Holyoke Water Power Company financed the construction of walkways, observation platforms, and a glass-walled underwater observation booth. Visitors can now watch the migrating fish as they swim through the 30-year-old fishway.⁷⁸



Solar

The simplest use of solar energy is to open a curtain and let the sunlight warm your house. More sophisticated versions of such "passive" solar techniques are now used to heat approximately one million American homes. This technology is thousands of years old. The ancient Anasazi cliff dwellings of the American Southwest relied on passive solar for much of their heat. The street and building layout of the Acoma pueblo in New Mexico demonstrates an intentional pattern to guarantee solar access for all the residents. Greek settlements in the fifth century B.C. were laid out to ensure solar access to all the buildings, and the Roman philosopher, Pliny, wrote about the *heliocaminus*, a solar greenhouse that was a part of his house.⁷⁹

Other solar principles such as overhangs, natural ventilation, and thermal mass (storing heat or coolness in the fabric of the building) can be used to keep buildings cool. By combining good solar design and energy efficiency, it is now possible to build homes in just about any climate that need almost no additional energy, yet stay comfortable year-round. Expanded use of passive solar designs is limited today only because many builders do not yet understand them. However, competition may encourage their use. The Swedes are now exporting prefabricated superinsulated/ passive solar homes to the U.S. It is also possible to add passive solar features to many existing buildings, as demonstrated by the San Luis example mentioned earlier.

Solar energy can also be captured in special collectors and used to heat water or to actively heat or cool buildings. Most collectors are rooftop solar panels, though there are others, including salt-laden solar ponds. Early versions of solar collectors provided energy for thousands of people in Florida and Southern California from the 1890s through the 1930s,⁸⁰ but the industry did not take off until after the 1970s energy crisis. Since then, some 800,000 systems have been sold in the U.S. Since 1981, enough solar collectors have been sold each year to heat water or air for 134,000 homes and a large number of businesses and industries. By 1985, the solar industry was a \$700-million-a-year business. However, following elimination of solar tax credits, the industry declined. In this country, "active" solar systems have tended to be complex and expensive, typically costing about \$4,000. In Israel and Australia, however, the market leans toward simpler systems averaging \$1,000. Many of these systems are now being imported; some American manufacturers are developing their own simple systems, some of which are equivalent or superior in performance to the fancy panels previously used.



Solar energy, like many renewable energy sources, can be used to create new jobs installing and manufacturing the equipment used to harvest the sun's energy. A project of the **North Carolina Alternative Energy Corporation** trains individuals and groups to establish self-sustaining community organizations that build solar devices. One of the spinoffs from this project is a church-initiated solar group called *Energy from Heaven*. This group builds low-cost window box collectors that sell for about \$60, solar water heaters at \$300, greenhouses from \$600 to \$1200, and hot-air collectors for south-facing walls. Participants can get a one-year interest-free loan and are charged 5% simple interest on any amount still due after the first year. Another group, the Solar Greenhouse Employment Project, holds workshops on solar collectors and solar greenhouses.⁸¹

In the mid-1970s, several welfare mothers in **Colton, California** bootstrapped a small federal grant into a multi-million-dollar business by hiring neighborhood youth to build and install weatherization and solar equipment. The benefits from using the equipment and the jobs and incomes that flow from making and selling it remain in the community — a striking example of how locally-made, locally-usable energy technologies can be a tool for community development.⁸²

Most people think solar energy can only provide medium-temperature heat. But, some high-tech collectors can heat water to the boiling point even on cloudy days in the Frostbelt. Sunlight can also be concentrated using mirrors, troughs, or parabolic dishes to deliver temperatures as high as 3,000°F — even higher if needed. An Israeli company and several American companies now lease or sell such equipment, some on a shared-savings basis. The solar heat can then be used to produce steam electricity or industrial heat. Though this use of the sun may someday provide much of our very-high-temperature energy needs, it is now often less economical than other ways to do the job. However, some of the latest and simplest solar-dish-collector designs are already at or near competitive prices.

Finally, sunlight can produce electricity directly using photovoltaic (solar) cells. Solar cells now power watches, calculators, spacecraft, remote facilities, and thousands of homes. Though the photovoltaic industry is only now reaching commercial stage, the cost of solar cells has fallen steadily; many experts expect solar electricity will soon compete with power from conventional sources. Today if you are building more than about a quarter-mile from existing powerlines, installing photovoltaics is usually less expensive than connecting to the powerlines. Some utilities are even building photovoltaic power plants. Others expect that home rooftop solar cells will be interconnected with the utility grid. Many countries are challenging America's technical lead in this field and some, such as Japan and Brazil, are already selling solar cells to developing countries.

The National Electricity Agency of Italy (ENEL) is installing photovoltaics on remote mountain homes and small islands where it is too expensive to string electrical lines. ENEL sells a package that includes a photovoltaic array, high-efficiency lights, water pump, refrigerator, television, batteries that store enough electricity to power the entire system, and a solar collector for hot water. Since 1986, 57 of the packages have been sold.⁸³ In the mountain wilderness of Colorado, a number of cross-country ski huts get their power from photovoltaic systems installed by students from Colorado Mountain College at Glenwood Springs. Remote Indian villages in the American Southwest and some National Parks facilities in the region are also now receiving their electricity from the sun.



Geothermal

Many communities are located near, or on top of, underground hot springs. This heat can be tapped for many uses. In **Glenwood Springs, Colorado**, a 115-room hotel is heated with the same hot springs water that bathers enjoy. In Iceland and several U.S. towns, geothermal water is used to make electricity and to provide heat for homes, industrial processes, commercial greenhouses, and aquaculture (fish farming). Several geothermal power plants are now in operation. Pacific Gas & Electric's geothermal facility at **The Geysers**, in northern California, produces 1,300 megawatts — as much as a large nuclear plant.

However, geothermal energy can have its problems. Many of the hot spots contain hazardous chemicals and salts which can be very corrosive. Many successful geothermal projects use hot water rather than steam. Pressurized-steam geothermal sources sometimes need water recharging to keep them renewable. For some communities, however, once the wells are drilled, a clean geothermal resource can provide essentially free energy.

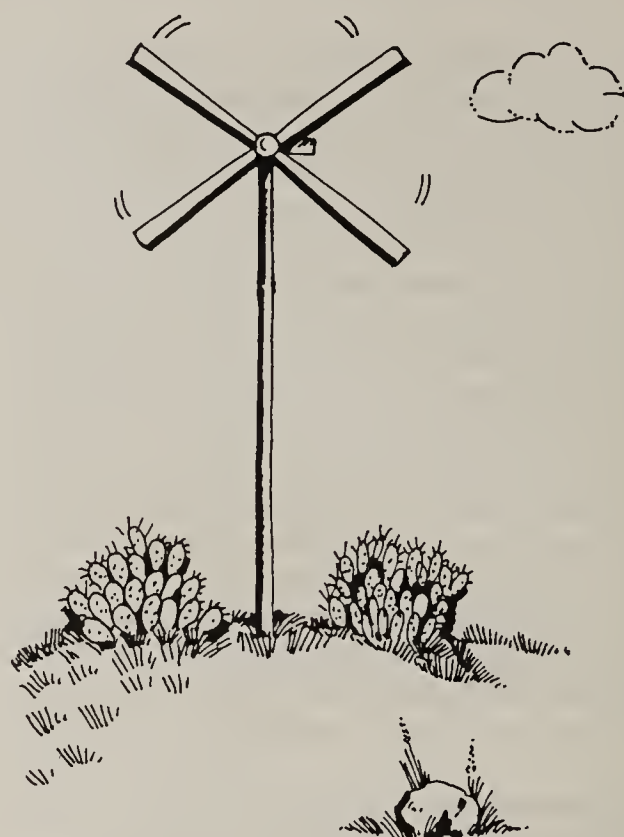
The largest geothermal district heating system in the country was recently developed in **San Bernardino, California**. Every minute 5,000 gallons of water leave the ground at 130° to 140°F from two wells. The system was

developed by the city's municipal water department and cost \$6.7 million.⁸⁴ Currently, 1.5 million square feet of building space is heated geothermally, and the system is only at 30% of capacity. The water from the well is clean and requires no treatment. Customers are billed according to how much heat they use (by BTU), at a rate that is 75% of current natural gas prices.⁸⁵

On a much smaller scale, the Geronimo Springs Museum, in **Truth or Consequences, New Mexico**, has tapped into a geothermal spring just a few feet from the museum walls. In this renewable energy demonstration project, water at 105°F is pumped from an 18' well through water-to-air heat exchangers to heat the museum. At the dedication ceremony the mayor said, "We're proud of this project. We would like to be able to install more geothermal systems around town. We have the hot water, and hopefully we can do it."

The project manager believes the town's geothermal resources could be a significant contributor to local economic development efforts. He said, "There is great potential throughout the city for similar projects. This project will help to encourage economic development of the area's geothermal resources."⁸⁶

Just as geothermal heating systems need not be huge engineering feats, small-scale geothermal electric generating plants are now possible. A company in **Carlsbad, California**, developed a small generating plant that can be moved to a potential geothermal site by truck. Wells for testing, production, and recharge are all drilled from one pad, cutting costs dramatically. The system uses Freon heated by the geothermal source to drive the turbines for generation. Since Freon boils at a much lower temperature than water, this type of generation system can be used for geothermal sources with temperatures lower than 400°F, as do an estimated 60% of U.S. geothermal resources.⁸⁷



Wind

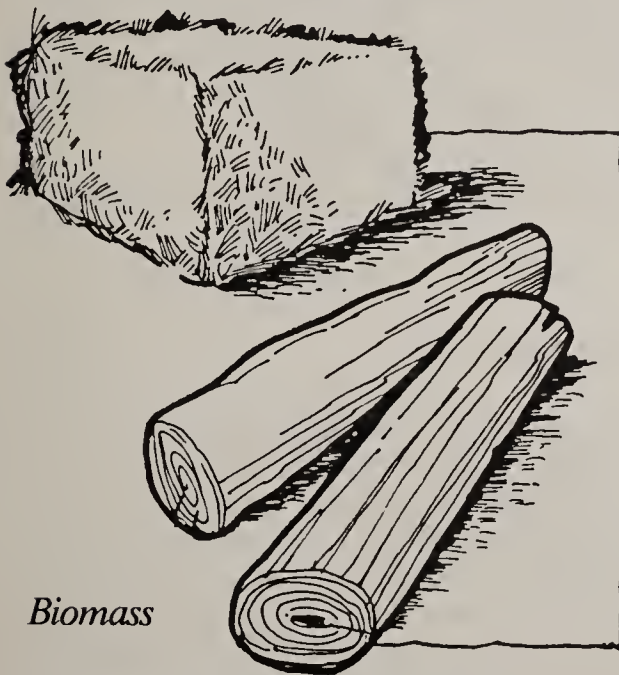
Wind energy, another ancient technology, has experienced a remarkable boom. Using wind to generate electricity was a \$500 million business in California in 1984. Over 8,000 wind machines have been installed since 1981. By 1986, more than enough wind machines had been completed to power several hundred thousand homes. The wind business initially relied on federal funding to build huge wind machines. Now the entrepreneurs are taking over, building smaller, more cost-effective machines. There are now commercial wind farms in California, Vermont, New Hampshire, Hawaii, Oregon, Massachusetts, New York, Wyoming, and Montana, with others planned in a number of states.

Popular in the early part of this century, home-sized windmills are now regaining popularity for farm and household use, with nearly 2,000 sold each year. Many U.S. utilities are experimenting with windpower. Experts estimate that windpower could be adding 1,000 megawatts to our supply each year (about as much wind power as was online in early 1986). Windfarms can be planned and built very quickly. For instance, one California windfarm developer leased a site in August 1985 and had a 20-megawatt windfarm online by December. In

contrast, it takes over ten years to build a conventional large power plant.

In Livingston, Montana, the municipal sewage treatment plant was powered by wind turbines. The city built a small windfarm with five 25-kilowatt wind turbines. Surplus electricity was sold to Montana Power Company. The city ran the project from 1980 to 1986, before shutting it down due to mechanical problems with the turbines. The city has not soured on wind, however; it now leases space in the windfarm to private investors. There are currently three wind machines on the farm, paying rent plus a percentage of the money they generate from electrical sales.⁸⁸

While most of the big American windfarms are located in California, Virginia Power Company is building a 1.5-megawatt windfarm. The project is a joint venture with a wind turbine manufacturer and will be located on top of Mount Storm in West Virginia.⁸⁹



Biomass

Wood is one of the most popular and widely-used renewables. Some 5.6 million homes are heated entirely by wood, and another 21 million are partly wood-heated. The air pollution problems that wood-burning can cause are being reduced by clean-burning woodstoves and by catalytic converters. Many industries have also turned to wood, accounting for some 64% of its energy use as a fuel.

Some communities in the East, where wood is plentiful, have even built wood-fired power plants. The National Wood Energy Association estimates that careful management of the nation's forests could produce eight to ten quads of wood-fueled energy each year, nearly triple the current amount; and could supply 20% of America's energy needs (more if the country used energy efficiently).

The city of Burlington, Vermont, converted a 10-megawatt coal-fired power station to burn local wood. Completed in October 1977, it burns 1,000 tons of "cull" wood each week. This commercially unmarketable wood is from diseased, dead, and dying trees. The trees are shredded into chips which fire the 6,000-gallon boiler. When the plant is running at full capacity, some oil is mixed with the wood chips. Burlington had been buying coal at \$50 a ton. Wood cost \$12 to \$13 per ton and three tons of wood provide the same energy content as one ton of coal. However, the savings for the city was even greater, because to meet pollution standards, the city was burning a mixture that was almost half oil along with the coal. The wood-fired plant produced about 10% of Burlington's electric needs, at a cost of 2.1¢ / kW-h, over 60% cheaper than the electricity that was generated by burning coal.

While many Vermonters felt that the project would benefit the local forests in the long run by weeding out deadwood, critics argued that it would encourage clearcutting and over-harvesting. But apparently the majority regarded the project a success; in 1978, Burlington voters approved a bond for a 500-megawatt plant that would burn 1,500 tons of wood daily.⁹⁰ Since completion in 1984, the big plant has been operating at projected costs. However, several problems have arisen. First, due to declining oil prices, the plant's electricity is more expensive than other sources. Second, the plant supplies more electricity than local demand. Third, the big, in-town plant's noise has prompted many complaints from Burlington residents.⁹¹

The Burlington experience is a valuable lesson for anyone thinking of renewable energy projects. Any energy project should be of an appropriate scale and based on realistic demand

projections. In Burlington, because several wood supply companies and many jobs are dependent on the power plant, utility officials feel they must continue to operate the plant. While the small converted wood plant was successful in every way, the larger wood plant was much more expensive and was based on unrealistic projections of electric demand.

Biomass is a potentially renewable resource that can be converted to liquid fuels. By some estimates, alcohol from crop and forestry wastes could provide enough fuels to power much or all of the U.S. vehicle fleet, if the vehicles were efficient. However, many of these wastes must be used to renew soil fertility. If they are converted to fuel without regard to soil fertility, agricultural production and rural economies will decline over time. But with careful management, biomass can meet many of our energy needs.

Some crops such as corn are raised specifically for biomass energy. Since 1980, 150 corn ethanol (alcohol) plants have been built in the U.S. These now produce over a half-billion gallons per year. According to the ethanol trade association, their product boosts octane in about 8% of U.S. gasoline. Many more plants are planned, but the U.S. still lags far behind Brazil, where alcohol provides over 40% of vehicle fuel. To reduce air pollution during winter months, the City of Denver, Colorado, requires that gasoline sold in the area contain a certain percentage of ethanol. It is estimated that alcohol-blended fuels could supply 10% of our vehicle fuel fairly soon. President Bush proposed in 1989 a mandatory move towards fuel-flexible cars and alcohol fuels.

There are many potential biomass energy sources. Someday we may get our fuels from plantations in the desert. At the **Gila River Indian Community in Arizona**, experiments are underway to determine potential uses for the native guayule plant. When harvested, 8% of the plant is used to make rubber (which is why Firestone Tire and Rubber Company is one of the project's backers). The rest of the plant is processed into fuel. Through pyrolysis, a process of applying high heat to produce vapors while not burning the material, the guayule is

turned into diesel fuel. The excess heat from the pyrolysis may be used to generate electricity.⁹² Sometimes local biomass resources can be used to produce an energy product for export. Farmers in **Julesburg, Colorado**, are marketing fireplace logs made from compressed straw. The farmers imported an English machine that compresses wheat straw into logs without adding binders. The logs, pound for pound, produce as much energy as wood and burn much cleaner. The operation was so successful that the farmers soon bought two more machines which quadrupled output.⁹³



Cogeneration

Cogeneration is not necessarily a renewable technology, but it offers tremendous opportunities to almost every community. Cogeneration, discussed earlier in this casebook, is production of both heat and electricity from the same heat source. For example, an industry which now burns oil or coal for heat could add an electrical turbine to produce its own electricity. Any surplus electricity could be sold to its utility under PURPA (the Public Utilities Regulatory Policy Act of 1978). The waste heat would be used to run the industrial process just as before. Although cogeneration can use solar heat, methane, or wood-fired boilers, most facilities now use gas turbines, coal-fired steam turbines, or diesel engines (especially low-speed diesels like those in ships) to turn electrical generators. Initially the primary applications

were in major factories making chemicals, steel, pulp and paper, and in oilfields where steam is used for tertiary recovery. But in the past few years, designers have realized that there are attractive opportunities in smaller plants and in the commercial sector. Hospitals, apartments, dairy farms, fast-food restaurants, hotels, laundromats, and car-washes can take advantage of cogeneration. Cogeneration can be considered wherever electricity is used along with a lot of heat, hot water, or refrigeration (including air conditioning). Off-the-shelf packaged units are now available in sizes from a few kilowatts to tens of megawatts. Do-it-yourselfers have built highly cost-effective cogenerators with simple ingredients. An old truck engine can be converted to burn natural gas. An old induction motor can be run backwards by the engine and become a generator. And a simple gadget can recover waste heat from the exhaust manifold. The typical payback period is one to four years. Spurred by such attractive economics, cogeneration in 1984 alone expanded from 5 to 7% of *total* U.S. electrical output, and is heading for at least 15% by the year 2000.

Business Incubators

During their initial years businesses are often fragile and prone to failure. Young companies need business and financial assistance and services that are often unavailable or unaffordable. Nationally, 80 to 90% of new firms do not see their fifth birthday. There are, however, ways to help overcome those odds. The business incubator is a relatively new idea that has had very impressive results in nurturing new business ventures. It is estimated that 85% of the tenants in incubators survive.

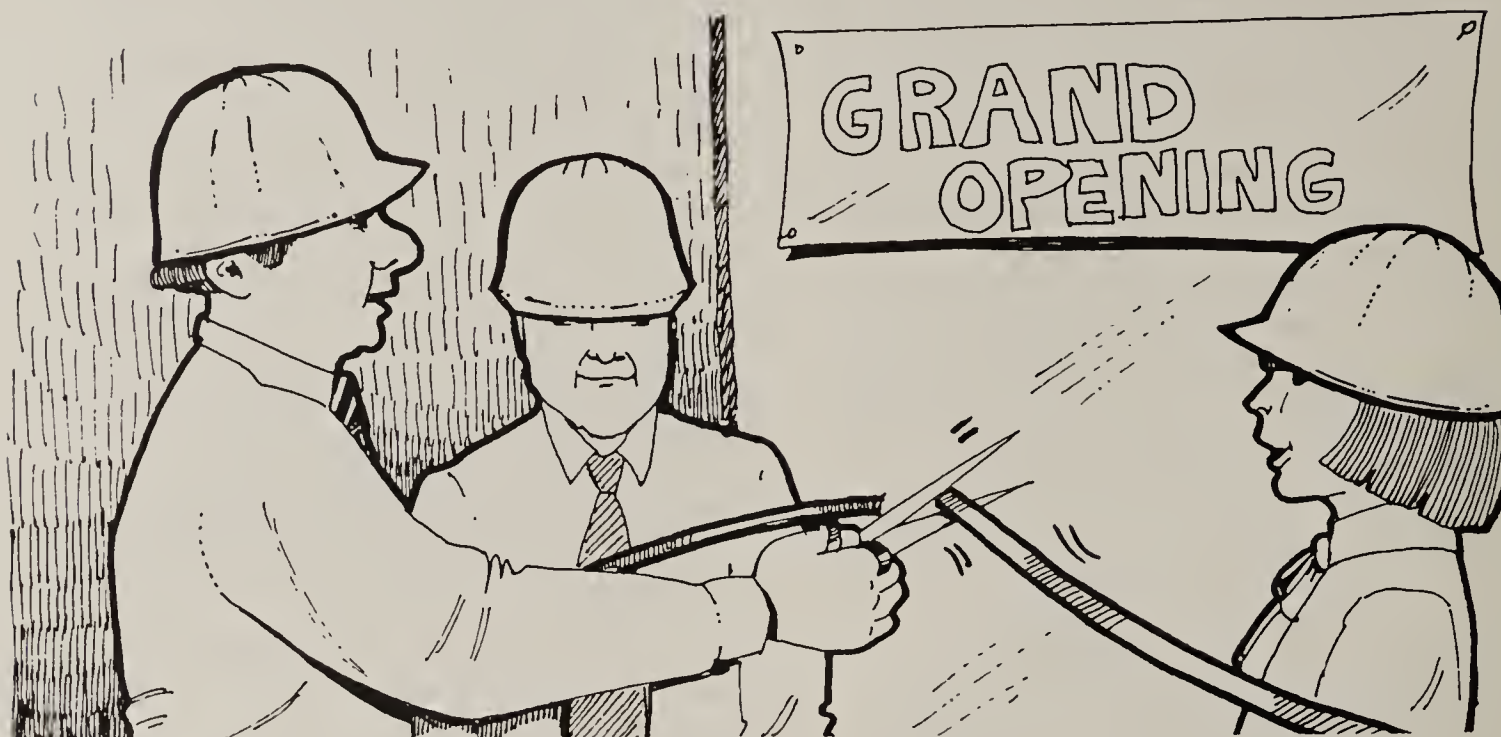
Though operated in many ways, business incubators generally share such features as multi-tenant facility rents below or at market rates, flexible space arrangements and leases, centralized services and equipment (e.g., photocopying) at low or no cost, business assistance and training programs, easy access to pertinent business information, financial assistance, and a relatively secure environment.

Dover-Foxcroft, a town of 4,000 in Maine, had a thriving economy centered around Brown's Mill. The wool mill, founded in the 1860s, was located on the north bank of the Piscataqua River and had its own hydroelectric plant. By the mid-1970s, the mill was gone and the town was economically depressed. In 1977, an inventor bought the 92,000 square-foot mill and began to turn things around. The mill had a \$100,000 mortgage, a janitor/chief engineer who had been there since 1939, and a hydroelectric dam. The inventor was determined to provide a breeding-ground for energy inventors and other dreamers. His criteria for businesses to move into the mill was, "new businesses will be encouraged to utilize local resources, avoid desecration of the environment, and produce products with real utility in an energy-short future."

Brown's Mill became a "post-petroleum age" business incubator. Space was rented in the mill for \$1 a day, including light from the hydroelectric facility and heat from a wood-fired boiler. The facility soon filled with cottage industries. The owner led workshops and live-in "dirty fingernail" courses on low energy technologies. He emphasized "hardware, not hog-wash."

Results were extraordinary; the old mill hatched some 86 projects. Some were the inventor's and others were started by the tenants. They included: an electrically-powered Volkswagen, a sawdust-fired furnace, solar collectors, biological waste disposal systems, and a venture to build life-size inflatable models of the 110' blue whale.⁹⁴ The inventor eventually sold Brown's Mill. It is now a large wood-shop that makes toys and furniture for a chain of resort-area stores. The hydro plant is still running as a part of the local utility and the wood boiler is still in use.⁹⁵

Business incubators can be a very effective way to support new ventures. As shown by Brown's Mill, they can be centered around one topic like energy, or be open to a wide range of business areas. Efficiency and end-use services, creating new energy sources from local resources, and business incubators are all successful energy related techniques for encouraging new local enterprise.



Principle #4: Recruit Compatible New Business

Recruitment of outside enterprise can bring significant local rewards, especially if done in a way that maximizes the return to the community.

However, when recruiting a major new enterprise, a community should ask itself whether its real goals will be enhanced by the proposed development. Will the new firm hire local people who need work? Will it pay its own infrastructure costs? Or will the new company compromise community values and squeeze out existing businesses? Will new revenues from the new industry pay for the costs of growth or merely keep up with inflation, leaving no new wealth to pay for the new costs?

Places such as Osage, Iowa, demonstrate that communities that have renewed themselves usually have no need to go begging for business. Self-acquired vitality makes towns far more attractive to new enterprise. By strengthening its own local economy through a variety of community energy projects, Osage attracted new industry. The energy projects added up to lower utility bills, an important incentive for new

industry. Energy economics are important now and will become critically important in the future. But economics are not all that a business looks for in considering a move. A positive community attitude is essential to successful recruitment. Through their successful energy projects, the citizens of Osage have developed a strong *can-do* attitude.

This section will explore two topics:

- structuring business recruitment incentives that make sense, and
- using existing energy resources or even byproducts to attract new business.

Incentives that Make Sense

Many communities, in the rush to capture outside business, offer incentive packages that include tax breaks, infrastructure, and reduced utility rates. But they must be careful. Sometimes these packages cost the community more than the value of the jobs that are created.

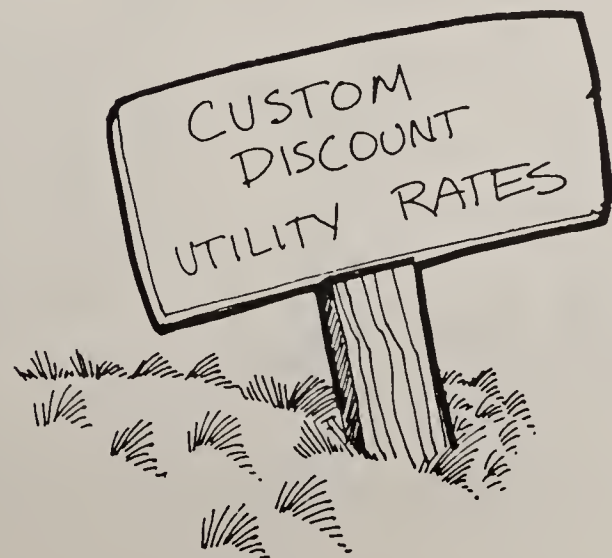
Many utilities are getting into the development game by offering low rates to incoming business. Cutting utility rates can lead to "an inventory clearance sale" mentality that may commit the local utility to build much more generating capacity⁹⁶ — potentially a burden on the entire community. This is not to say that utility incentives are always a bad idea, rather they have to be carefully structured. Generic utility incentives do not appear to have a significant effect on the success of recruitment efforts; however, "custom-designed incentives" seem to work.⁹⁷ Generic rates typically are flat discounts on bills. In contrast, custom packages of rates and services, often including efficiency improvements, are tailored to fit the specific needs of a particular business.

Cutting rates for incoming businesses can create ill feelings among existing businesses. One approach, created by Santee Cooper, a utility in South Carolina, works for both new and existing businesses. This "catalytic" rate, approved by South Carolina Public Service Authority, is in effect in 35 counties in the state. The rate gives bonuses for being energy-efficient.

Any existing business that expands, or a new business that enters the Santee Cooper service area and creates 10 new jobs for each megawatt of new electricity demand, receives a 30% discount on the demand portion of its electric bill (the fixed amount charged by the utility). If 11 to 20 jobs are created, the industry receives a 35% discount. If more than 20 jobs are created per megawatt of demand, the business gets a 40% discount. The rate offer was designed to be in effect for a six-year period.⁹⁸

There are other ways in which local utilities can get involved in the recruitment process. Many utilities have a very good picture of an area's existing businesses. This information can become a data base for incoming businesses and for local businesses looking for local suppliers. Additionally, utilities can provide seed money for economic development. Some utilities give funds to regional development groups.⁹⁹ A recent legal change will allow rural electric coops to make economic development loans up to 15% of the value of the utility's physical plant.

Wisconsin Power & Light Company (WP&L) provides shared-savings energy-efficiency projects with local business and agriculture. The projects have a maximum five-year contract and are sometimes financed as joint ventures of the utility, local banks, and the business being served. Two examples of the types of projects undertaken are a wood-waste cogeneration system and an energy retrofit of a dairy operation. This shared-savings program has been very successful and has attracted attention outside of WP&L's service area. Recently WP&L was approached by another utility that wanted to franchise WP&L's program. It seems the other utility had been told by some of its manufacturing customers that they were thinking about moving to Wisconsin so they could take part in WP&L's efficiency program.¹⁰⁰



Energy Resources to Attract New Business

Selling the rights to develop an existing resource — such as allowing an outside company to start hydro generation on an existing dam (see the Old Burlington Dam example in *Principle III, Hydro*) or leasing space on a wind farm (see the Livingston, Montana, example in *Principle III, Wind*) — is one way to attract new business. There are other creative ways to attract new business.

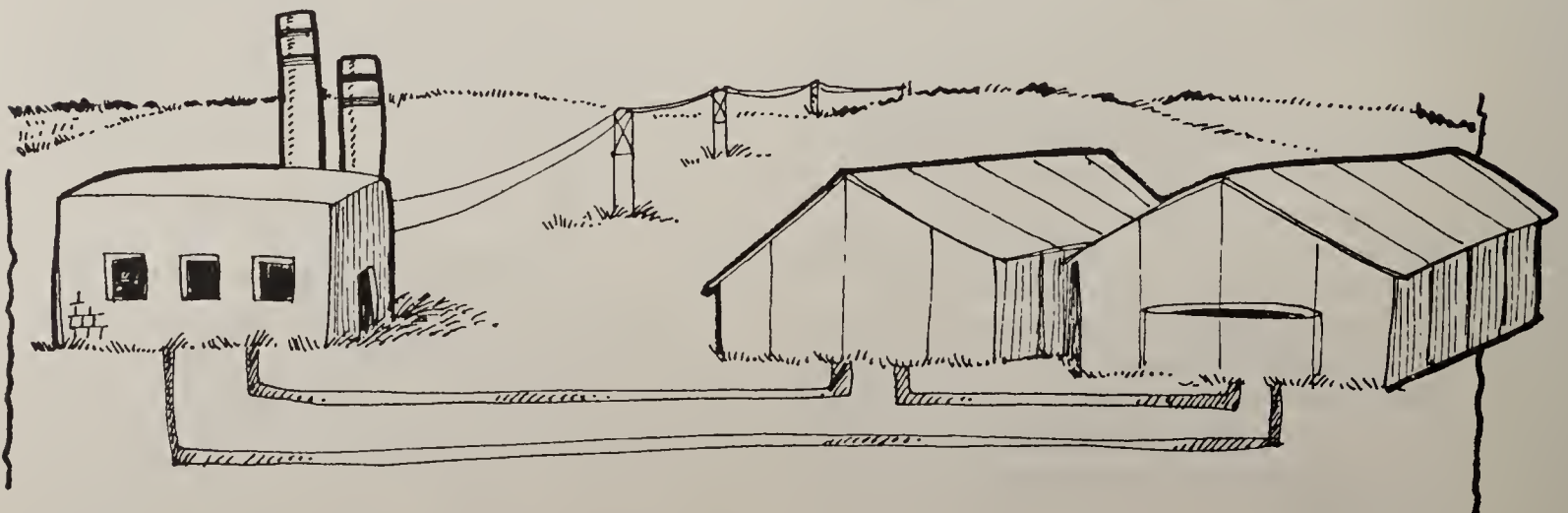
The Neoplan bus factory in Lamar, Colorado, is frequently cited as an example of successful business recruitment. While most discussions of how Lamar captured the German company's first U.S. manufacturing facility typically focus on the town's aggressive efforts, a unique incentive offered by the town is overlooked. The new factory was sited next to the town's existing power plant. The power plant became a large cogeneration facility when heat from its cooling system was offered to the bus company to heat its facility. The Neoplan factory receives heat from the 5500-gallon-per-minute of 92°F water from the municipal power plant. The factory has three heat exchangers for drawing off the heat and is not charged for the system. The city may, however, start charging Neoplan a nominal fee to cover monitoring cost on the system.¹⁰¹ It is unclear how important the heat offer was to Neoplan's decision to site in Lamar. However,

the feeling in Lamar is that it may have been significant.

The new factory created 500 new jobs for Lamar. Additionally, a fiberglass components company and a bus air-conditioning manufacturer have moved in to supply Neoplan. The local utilities board superintendent said, "What we did was offer energy assistance to industry at basically no cost to us, and industry seemed to like it."¹⁰²

The waste heat is now being offered to other facilities in the industrial park adjacent to the power plant. These companies will, however, be charged the cost of connecting to the system.

In Rifle, Colorado, a new cogeneration facility became the centerpiece of a local effort to attract new ventures. Heat from the power plant is used to warm greenhouses in which tomatoes are grown for regional supermarkets. Heat is also used to warm the water at a local oyster ranch. Oyster ranch? Yep, a Rocky Mountain oyster ranch, where 40,000 pounds of oysters are brought in each week to be purified and fattened in the clean Colorado water — water heated by the Rifle cogeneration facility.¹⁰³ The company is currently on hold while financial arrangements are settled.¹⁰⁴ This is clearly a creative example of using local energy resources to attract new business.



Conclusion

As has been demonstrated by the successful projects mentioned in this casebook, there are many ways communities can use energy projects to plug the leaks in their economy, support existing business, encourage new local enterprise, and attract new businesses that are compatible with the community.

More efficient energy use is helping communities deal with their dollar drain. The whole country, which is the sum of its communities, is also benefiting. Our nation's energy bills today are about \$150 billion less than they would have been if we still used energy as inefficiently as we did in 1973. But if we were as efficient as Western Europe and Japan, we would save an additional \$200 billion a year. That's enough to wipe out the federal deficit, or to put an extra \$800 a year back in the pockets of every woman, man, and child in America. Indeed, by the year 2000, just by choosing the best energy buys, we could save several *trillion* of today's dollars — more than enough to pay off the entire National Debt!¹⁰⁵ Saving energy at home reduces household energy costs and effectively creates new tax-free personal income. Saving energy at work reduces business expenses, a saving that goes straight to the bottom line. Saving energy may be the single most effective way to keep more money recirculating in both national and local economies.



Appendix

The Role of Utilities in Economic Development and Energy Efficiency

A utility is uniquely qualified to affect a community's economic development. It provides a basic and vital service to businesses, government, and individuals; it is nearly always one of the largest businesses in town; it may know more about the number, variety, and condition of local businesses than any other entity; a utility's capital and infrastructure requirements are generally matched only by those of governments; and its horizon for planning far exceeds that of virtually any other entity because decades are required to build and pay off a large power plant. Though, in most cases, it is a profit-making company, a utility's economic influence can, in many ways, be even more profound than that of local government.

This appendix explores the successful efforts of utilities to improve energy efficiency and enhance economic development. Examining policies, programs, and projects, it is divided into three topics:

- energy-efficiency and capacity considerations
- the economic development efforts of utilities
- utility-to-utility support programs

Energy Efficiency and Capacity Considerations

In the face of excess capacity, the development of energy efficiency policies might seem counterproductive. But a number of utilities have done just that. In fact, some are beginning to see efficiency measures as essential opportunities regardless of current capacity. Since capacity represents a sunk cost, whereas the variable costs of operating that capacity are still avoidable, any utility should buy all

efficiency measures that cost less than its marginal operating costs, regardless of how much capacity it has. One-cent-per-kW-h efficiency should always be dispatched before 2¢/kW-h generation in order to minimize service cost and customers' bills.¹⁰⁶ Providing most efficiency, using the best available technologies, costs *much* less than 2¢/kW-h.

To ignore efficiency or to openly promote inefficient uses of electricity during a period of excess capacity locks in technologies and uses that are difficult and costly to change later. Decreasing block rates exacerbate this situation. In addition, although discount rates may seem to be an easy incentive to offer for industrial recruitment, their actual track record is less than impressive.¹⁰⁷ (See Incentives That Make Sense; page 38.)

Discounting rates, a traditional response to overcapacity, assumes that industries want lower rates per kilowatt-hour, when their true desire lies simply in lower *bills* for energy services. Cutting rates supports industry only as long as the discounts remain intact, whereas efficiency improvements in industrial processes do not expire: a permanent bill cut is better for the customer than a temporary rate cut. Moreover, one customer's rate cut is another's rate hike; wealth is only transferred within the community, since no outside money finances the demand growth. In contrast, improving any customer's efficiency more cheaply than the utility can generate the same amount of power will make the customer *and all others* better off. Efficiency programs tend to be spread across all classes of customers (residential, small businesses, institutional, commercial, and industrial) as opposed to the inherent inequities of rate discounts to which only large commercial and industrial customers have access — and frequently only if they are new to the service territory.¹⁰⁸

To overlook efficiency during an interval of excess capacity may lead the utility, and its customers, to missing opportunities to save money over the long run. The **Northwest Power Planning Council** calls these "lost opportunity resources," which are "...cost-effective resources that would lose their cost-effectiveness if not developed or maintained in the near term. Consequently, their savings could be lost forever to the region. A primary example of such a lost opportunity resource is the energy efficiency of new buildings. Since many energy saving measures cannot be installed cost-effectively later, buildings constructed without these measures will continue consuming energy inefficiently long after the surplus is over."¹⁰⁹

Out-of-territory wholesaling is an opportunity, too, that may be lost by selling the electricity at discounted rates during a period of excess capacity. Frequently this power could be sold to other utilities in multi-year, set-megawatt blocks at rates higher than the discounted retail rates. It may be argued that selling this power elsewhere makes it unavailable to the utility, should it find that the capacity is needed before the end of the contract. However, if the power has already been contracted at even lower rates to in-territory uses, it is just as unavailable. Additionally, if the power is locked up in inefficient uses, it may commit the utility to building more capacity.¹¹⁰

Boston Edison Company recently stated that efficiency programs financed by utilities should be viewed as "...not simply a response to transitory shortages of capacity, but an ongoing part of any successful long-term campaign to minimize the economic and environmental costs of energy services: Some see in New England's push for energy efficiency merely a reaction to near-term capacity constraints, which may be more pressing than those facing other regions. We strongly disagree. Energy efficiency has a permanent role in cutting both short- and long-term energy bills, improving regional competitiveness and environmental quality, and reducing costly uncertainty about future energy needs. Market barriers to conservation are pervasive, and block numerous efficiency opportunities that are cost effective. Moreover, many buildings, appliances, and industrial processes will long outlast today's energy supply

balance. Finding and removing obstacles to inexpensive and/or long-lived savings is good public policy, regardless of a utility system's immediate needs for new generating capacity."¹¹¹

Energy efficiency should be viewed as a tool and a resource for utilities regardless of whether there is capacity shortfall or excess. Again, from **Boston Edison Company**: energy efficiency "...should be allowed to compete on equal terms with generators for access to utilities' resource acquisition budgets, including funds allocated through bidding systems: Increasingly, utilities are turning to competitive markets to meet any power needs that remain after deployment of governmental efficiency programs. California and New England have been leaders in developing the new power supply 'auctions;' we should...ensure that they are structured so that demand and supply options can compete without bias for utility investments allocated in this way."¹¹²

In many states, the concept of demand and supply options competing equally may require regulatory changes, but it is already in successful use in Maine. **Central Maine Power Company** has launched a bidding process in which demand-side and supply-side offers genuinely compete. After an all-source solicitation in December 1987, Central Maine Power was offered 13 efficiency bids ranging from 50 kW to 10 MW (of saved electricity), totalling around 35.5 MW, and between 40 and 50 MW of supply-side bids.¹¹³ At least seven other states are already implementing all-source bidding, and the trend is spreading fast.

As utilities face increasing competition from energy service companies, independent power producers, and cogenerators, nontraditional management concepts such as "lost opportunity resources" and all-source power bidding are bound to become powerful tools for making more money at less risk, and providing better service at lower cost. Energy-efficiency programs are prudent and profitable measures, even for utilities with excess capacity.

The Economic Development Efforts of Utilities

Examples of creative economic development programs undertaken by utilities are found nationwide. Most go beyond traditional strategies such as rate incentives and information banks. They include ventures that are based on the richness of local resources and conditions.

An excellent example is the **Osage Municipal Utilities'** energy efficiency campaign. Through utility and community cooperation, local businesses have been able to lower overhead, homeowners have reduced household energy expenditures, and the utility has been able to reduce rates. These projects improved the health of the local economy beyond many in the state and helped attract new industry to Osage. (See page 9.)

Utility-sponsored energy-efficiency programs and energy-services ventures provide help for local businesses and a potential unregulated income stream for utilities. Examples such as **Puget Energy Services** and **FPL Energy Services** are subsidiaries of utilities. (See page 26.) **Wisconsin Power & Light's** shared-savings energy-efficiency program has become an incentive for recruiting new industry. (See page 39.)

Citizen committees advise **Seattle City Light** (a municipal utility), the mayor, and the city council on such issues as rates, load forecasts, alternative energy resources, conservation policies, conventional generating facilities, and efficiency standards.¹¹⁴ The first committee was formed by the utility in 1972 to advise on rates. This committee also advised the utility to hire an environmentalist and an economist, starting a long and fruitful collaboration with the citizens of Seattle. While other committees are convened as needed, the broadly-representative rate committee is most active during biennial rate hearings. The utility ensures that the committee has representatives from business, residential, low-income, senior, and other interest groups. To attract potential committee members, the utility places ads in local papers and maintains a large mailing list of interested

parties. Recently, the utility initiated issue-specific customer forums that involve customers in a short-term series of meetings.¹¹⁵ While **Seattle City Light's** Public Involvement Program is not focused strictly on development of the local economy, it is a bridge to customers that improves the utility's responsiveness to development issues.

To better understand potential economic growth and load growth, a utility in **Middleborough, Massachusetts**, commissioned a study of city lots. The study provided information on zoning, potential density, and types of industry or commercial uses that might be expected. While the utility was primarily concerned with the effect of future development on distribution and generation, the study also provided the municipal government with a better grasp on its future infrastructure demands.¹¹⁶

Noticing that the local rose nursery industry was blooming, **Richmond (Indiana) Power and Light** undertook a study to help reduce greenhouse energy costs. One grower, with a million square feet under glass, was paying \$6.50/MBTU for oil heat, while nearby the **Richmond State Hospital** was producing steam in its coil-fired boilers for \$2.25/MBTU. The utility proposed laying pipelines to connect the two facilities. The venture was to be financed through shared savings (between the utility, state, and grower), with construction costs covered by the state. Once the system was paid off, the utility would still receive income from the wheeling charges derived from pumping the steam from the hospital to the grower.

Richmond Power and Light also investigated connecting a number of other enterprises onto the system, including another rose nursery with 800,000 square feet under glass. Unfortunately, system financing depended on state monies; after two years, the state turned down the project. Though oil prices declined in the meantime, the utility has not soured on the idea. When oil prices rise again, the utility may proceed.¹¹⁷

While the **Richmond** project was proposed to support an existing business, it also demonstrates two potential income sources for utilities. The utility could receive income, first,

through the shared-savings financing of the construction, and second, from the charges for wheeling the steam from the hospital to the rose nursery. Neither of these potential income streams would require the utility to build extra capacity or sell more electricity.

Through creative thinking, utility wastes can become an economic development asset. **Public Service Company of San Antonio** sells the fly ash from one of its facilities to a concrete admixtures plant that was sited near its facility. Fifty new jobs were created, and the utility receives income from a waste.¹¹⁸ This type of thinking is also evident in the use of waste heat from cooling systems as the basis for district heating or greenhouse and aquaculture operations. (See the **Lamar bus manufacturing** and **Rifle Oyster Ranch** examples on page 40.)

The cooling reservoirs of some Texas power plants are stocked by the Texas Parks and Wildlife Commission to encourage sport fishing. The **John Wilson Marine Hatchery**, on the Texas coast, raises saltwater fingerlings in effluent water from a **Central Power and Light** facility.¹¹⁹

A South Carolina public utility, **Santee Cooper**, has gone even further. In 1977, the utility set out to solve a maintenance problem at the **Winyah Generating Station**: rapidly-growing algae and other aquatic plants were clogging the warm environment of discharge canals and cooling ponds. **Santee Cooper** began raising **Tilapia** in the discharge canals. **Tilapia** ("St. Peter's fish," from the biblical story of loaves and fishes) are members of an African/Mideastern family of fish that grow rapidly, breed easily, love to eat algae, tolerate wide ranges of environmental conditions, and are widely used as a tasty variety for aquaculture. During the winter, discharge water is used to heat indoor hatchery ponds that are part of a venture that annually sells over 2 million **Tilapia**. The **Tilapia** are sold to universities, aquaculturists, utilities, towns (to keep domestic water supply ponds and reservoirs clean without herbicides) and golf courses. **Tilapia** replace herbicides that would have been used to keep golf course lakes clear. The lakes can then be used as a source of water for the grass.

Santee Cooper also raises grass carp that eat rapid-growing aquatic weeds. Recently, the utility began raising channel catfish in floating cages at a cost of 25 to 30¢/lb. Due to their warmer environment, the catfish take only about a year to reach a size of 1 to 1½lbs. In 1988, with only 12 cages in production, **Santee Cooper** sold 12,000 lbs of catfish to a commercial processor at 75¢/lb.¹²⁰ **Santee Cooper's** maintenance problem has become a profit-making venture.

Energy efficiency services, citizen advisory committees, planning studies, district heating systems, selling fly ash, and warming fish ponds are just a few ways that utilities have gotten creatively involved in economic development. These projects have created jobs for the local community and new income for the utility.

Utility-to-Utility Support Programs

The **Energy Services Exchange (ESE)** was created by the **Western Area Power Administration (WAPA)** and the **American Public Power Association (APPA)**. This inventive program "...promotes the sharing of expertise and experience among local, consumer-owned electric utilities."¹²¹ It sets up "peer matches:" meetings with people from utilities that have faced similar problems or are in need of technical support.

The **ESE** provides information packets on 30 topics, referrals to utility personnel who can serve as technical advisors, workshops on such topics as demand-side management or distribution loss reduction, and onsite peer matches. All of these services can be accessed by calling (800) 824-5424.

The peer match program may be the most exciting aspect of the Energy Services Exchange. The following paragraphs cover the results of peer matches between Weber Basin Water Conservancy District and Medina Electric Cooperative, Osage Municipal Utilities and Boulder City, Estes Park Light and Power and the Town of Haxtun, the Iowa Association of Municipal Utilities, Southern Minnesota Municipal Power Agency and the Moorhead Public Service Commission.

Weber Basin Water Conservancy District and Medina Electric Cooperative

The Weber Basin Water Conservancy District in Layton, Utah, experiences very costly summer peaks due to irrigation pumping. Its problems are very similar to those experienced by the Medina Electric cooperative in Hondo, Texas. (See Hondo, page 22.) Weber Basin hopes to replicate the success of the Medina load-management program. With that purpose in mind, two Weber Basin representatives visited the Medina facilities in April 1989.

The peer match agenda included discussions on the design and technical aspects of the Medina load management system, strategy for involving customers, and feasibility and results of using the system. Additionally, the Weber Basin representatives toured Medina's load-management equipment.¹²²

As a result of the peer match, Weber Basin is planning to install a Supervisory Control and Data Acquisition (SCADA) system. A SCADA system will allow the utility to monitor several hundred load sites and shave load through the use of remote radio control devices. Weber Basin currently experiences an 8 MW summer peak, of which 4 MW is supplied by WAPA. They generate 2 MW and buy 2 MW. They hope to shave off the last 2 MW of demand with the SCADA load management system.¹²³ As of

July 1989, Weber Basin was preparing a request for proposal for SCADA system vendors.¹²⁴

Osage Municipal Utilities and City of Boulder City

Osage is a small north central Iowa community with 8,000 degree-days of heating load. Boulder City, Nevada, is a bedroom community near Las Vegas with 3,000 heating and 7,000 cooling degree-days. Their conditions seem very different. But when the two communities were matched in 1986, Boulder City was facing many of the same problems that Osage had seen.¹²⁵ (See Osage, page 9.)

Boulder City receives power from nearby Hoover Dam at 1¢/kW-h. However, in 1986, the city was near to exceeding its allocation of power from the dam. The next cheapest source available for a long-term contract was selling for 4.5¢/kW-h, a 400% increase. Worse, Boulder City needed short-term peak power, which is even more expensive.

The Osage program was explained in the 1986 exchange. Several programmatic suggestions were recommended: free energy audits, installation of swimming pool pump triggers, initiation of a community-wide load-management program, and the hiring (with WAPA support) of a conservation specialist.

Since that time, a number of projects have been initiated. These include:

- Free energy audits, including installation of \$30 of free weatherization materials
- Free insulation retrofitting
- Hiring an efficiency specialist
- Adoption of increasing block rates
- Retrofitting of city facilities, including insulation, lighting retrofits, swimming pool covers, and water-heater setbacks
- Metering of previously unmetered loads
- Free replacement of electric space and water heating systems with gas systems, financed by the local gas company
- Dedication of city block grants to low-income retrofits

Boulder City has gotten good publicity for its efforts; public reception of these and other ideas

has been very good. The City is also investigating installation of a community-wide SCADA system. A SCADA system would provide a database for operations and create a 3,000-point load-management system. (Nearby Las Vegas already has a well-received load-management system in operation.) Industrial power rates will probably be shifted to time-of-use rates. In addition, the city council has moved toward adoption of a performance-based building hookup fee. The fee will be \$3,000 (a 500% increase over current fees), with a menu of energy-efficiency options that can incrementally reduce the fee to \$1,000.¹²⁶

Boulder City officials feel that they have just begun to scratch the surface of possible energy efficiency savings for their community.

Town of Estes Park Light and Power Department and the Town of Haxtun

Haxtun, Colorado, has a population of 1,000 with 463 meters. The municipal utility was buying over 7 million kW-h from WAPA and the Nebraska Municipal Power Pool, while billing only 5.6 million kW-h. This would seem to indicate that the town's electric system had 19% losses.

A peer match was arranged in May 1989. It involved representatives from WAPA, Platte River Power Authority, Fort Collins Light and Power Department, Loveland Department of Light and Power, Estes Park Light and Power Department, and the Town of Haxtun. Inspecting Haxtun's distribution system, these experts checked billing procedures, wholesale metering, retail metering, and unmetered loads.

The inspection revealed that the town's distribution system was generally in good shape, and that the majority of system losses could be accounted by unmetered loads and incorrect meter multipliers. The town was supplying unmetered power to street lighting, city buildings, town swimming pool, park, community center, and four pumps on the wells that supply drinking water. Taking these loads and some improperly billed loads into account

indicated that Haxtun's actual system losses are around 4%. The visiting representatives recommended that Haxtun begin metering government-related loads, and correct billing procedures, meter multipliers, and powerline clearance infractions.

Haxtun officials are very pleased with the results of the peer match. They have begun to correct metering problems and, as revenues allow, will add meters and retrofit powerline connections.¹²⁷

Moorhead Public Service Commission

The Public Service Department of Moorhead, Minnesota, (population: 30,000) supplies power to 11,000 residential meters and 1,600 commercial/ industrial customers. The utility recently helped to establish cogeneration at the American Crystal Sugar sugar-beet processing plant. It has also worked with the community to establish a load-management program that is intended to shave 10 MW off the winter peak and 4 MW off the summer peak.¹²⁸

In 1986, the City of Moorhead established an Economic Development Authority that later requested \$500,000 from the Moorhead Public Service Commission to help fund a large business recruitment plan. But utility officials wanted to learn about other utilities' economic development experiences before deciding on granting this large sum. They felt that focusing exclusively on industrial recruitment would short change development efforts. Therefore, they requested an ESE peer match to educate themselves and the city council.

As part of the peer match, a representative of the Iowa Association of Municipal Utilities presented computer software that helps identify possible parallel energy service projects and economic development programs. To make recommendations on the kinds of energy services programs that will satisfy various economic needs, the software uses various inputs such as energy dollar retention ratios, numbers of jobs per dollars of salary, discount rate, and energy costs.

A representative of the Southern Minnesota Municipal Power Agency (SMMPA) discussed the economic development activities of member utilities. SMMPA recommended that "...Moorhead should be stressing energy efficiency (~~not~~ conservation) to its commercial/industrial customers. He thought that the appliance rebate program [which Moorhead PSC was considering], if it included motors and ASD's, was a good idea. He plugged computer-grade electric service as a hot area for Moorhead to get into. He downplayed incentive rates somewhat, stressing that Moorhead already had exceptionally low rates and just needed better promotion. He floated the idea of hiring an industrial process engineer for Moorhead whose purpose would be to become intimate with all of Moorhead's commercial/industrial end-use processes so that Moorhead could better serve existing customers."¹²⁹

Following the peer match, the Commission decided that granting the \$500,000 was riskier than pursuing a course of economic development that would focus on expanding support for existing businesses, promoting the utility's low rates, and exploring ways for the utility to work with the economic development authority. Moorhead Public Service is hiring an energy efficiency expert to work with existing businesses and help establish energy services for incoming businesses.¹³⁰

Weber Basin, Boulder City, Haxtun, and Moorhead are just four examples of over 25 peer matches that have taken place since 1984 when WAPA and APPA started this nationwide program. Participants in the peer matches discussed here feel that the program was extremely valuable and that the results have been quite positive.

Glossary

Active Solar systems use mechanical devices (pumps, fans, etc.) that transfer collected heat to the storage medium and/or the end-use.

Base load is the amount of gas or electricity steadily required by customers of a utility, at a minimum, over a period of time. Some times more is required, rising to the maximum "peak load" at certain periods. [see Demand]

Biomass is potentially renewable, biologically-derived energy. It includes such forms as wood, peat, crops, and crop wastes. Though coal and petroleum originated as biomass, they are not renewable because they are consumed faster than they are created. Biomass can be readily converted to such fuels as methane, methanol, and ethanol.

BTU (British Thermal Unit) a unit of energy roughly equivalent to the energy released by burning a kitchen match. Often used in space heating and cooling calculations, it is the amount of energy required to raise one pound of water one Fahrenheit degree (1F°) above 39.2°F.

Capacity is the maximum rate of power-generation a utility's equipment will support. It is typically measured in megawatts (MWs), or gigawatts (GWs). Expansion of capacity usually requires building additional generating equipment.

Cogeneration is the joint production and use of electricity and heat. Typically, electricity is the primary output of such large facilities as power plants. As a byproduct, heat can be used in, for instance, food processing, district heating, or oil recovery. In contrast, small systems (e.g., laundromats, health clubs, and car washes) may be designed primarily to heat water while the generation of electricity is secondary.

Coulombs are units of electric charge. Named for an 18th century French physicist, Charles Augustin de Coulomb, a coulomb equals one ampere of electric current for one second.

Demand is the rate at which energy is required by consumers at any particular time. Frequently this term is used in relation to base load demand or peak demand on an electric grid or gas pipeline.

Demand Charges on an electric bill are based on the maximum amount of power that a given customer uses in any instant, measured during a given month or some other period.

Demand Management refers to programs that attempt to control how much and when customers use energy. These programs are sometimes used to avoid construction of additional capacity, especially peak capacity, and to balance a utility's load between peak and off-peak periods.

District Heating systems distribute hot water or steam to several buildings through pipes from a heat-producing facility such as a boiler, cogeneration facility, large solar system, or geothermal resource. District cooling systems circulate chilled water to air-condition groups of buildings.

End-use is the task or purpose for which energy is required. Examples include lighting dark spaces, cooking food, and powering vehicles.

Energy Conservation means using less energy. Conservation can imply a lifestyle change or reduced level of service. Lowering thermostat settings is an example of energy conservation.

Energy Efficiency means using less energy to perform the same tasks. A device is energy-efficient, as the term is used here, only if it provides comparable or better quality of service than that which it replaces.

Energy Services Companies sell and/or install energy efficiency technologies.

Geothermal energy sources, such as geysers and hot springs, capture heat from within the earth

to generate electricity, run district heating systems, and provide industrial process heat.

Gigawatt is a billion watts.

Hydro [electric] power is electricity that is produced when falling water turns generators. It is a renewable energy source derived from gravity and rain.

Import Substitution is the replacement of a product or service that is purchased outside the community (*e.g.*, natural gas) with a locally produced product or service (*e.g.*, solar or wood).

kVA (kilovoltampere) is a rate of delivering electrical energy, some of which may not be able to do useful work because the current and voltage are not in phase. Kilowatts (kW) count only energy that can do useful work. [see Demand Charge]

kW-h (kilowatt-hour) is a unit of electric energy delivered over time. A kilowatt-hour is 1000 watts delivered for one hour, or an equivalent combination.

Load Management [see Demand Management]

Megawatt is a million watts.

Microhydro systems are very small hydropower generation facilities, generally producing up to 50 kilowatts.

Off-Peak is the time when demand is at or near a utility's base load (*e.g.*, at night). Utilities will sometimes offer reduced rates to large customers if they agree to switch operations to off-peak periods.

Passive Solar systems collect, move, and store heat using natural heat-transfer mechanisms such as conduction and air convection currents.

Peak Load is the period of highest demand on a utility — typically occurring when customers run their air conditioners on the hottest days of the year or when they heat their homes on the coldest days. Though peaks in demand occur daily, they are usually not as dramatic as the

weather related peaks. [see Demand Management]

Photovoltaics are solid-state cells (typically made from silicon) that directly convert light into electricity.

Quads (quadrillion BTUs) are very large units of energy measurement often used in examining national energy use. Total U.S. energy use is about 80 quads per year. One quad = 1,000,000,000,000,000 BTU.

Renewable resources are created or produced at least as fast as they are consumed, so that nothing is depleted. If properly managed, renewable energy resources (*e.g.*, solar, hydro, wind power, biomass, and geothermal) should last as long as the sun shines, rivers flow, wind blows, and plants grow.

Retrofit is the replacement, upgrade or improvement of a piece of equipment or structure in an existing building or facility.

Shared Savings are financed by the money saved by improving energy efficiency, which is then "shared" between the company that paid for the equipment and the company or individual whose energy use was reduced.

Sliding-Scale Fees are used in a program which charges high hookup fees for inefficient buildings and low fees or rebates for efficient buildings. This is a reward ("carrot") and penalty ("stick") approach to encouraging efficiency in buildings.

Solar energy systems capture and convert sunlight into other forms of energy. [see Active Solar, Passive Solar, Photovoltaics]

Superinsulation minimizes the amount of heat that can escape from (or, in a hot climate, enter) a building. Superinsulated buildings often do not contain a furnace. They may derive all their heat from sunlight, a small wood stove, household appliances, occupants, and their pets. Typically, superinsulated buildings in cold climates use less energy for space heating than for water heating.

Supply-side strategies attempt to provide energy services by increasing or changing energy sources. In contrast, demand-side strategies identify the least costly ways to serve each discrete end-use.

Sustainable activity can be perpetuated continuously for future generations. Sustainable systems are adaptable and resilient. They do not deplete resources or the culture that uses them.

Waste-Burn plants burn trash to generate electricity. Recyclable materials are separated out of the fuel in Refuse Derived Fuel plants; in contrast, Mass Burn plants burn everything.

Watts are units of power or rates of flow of energy. Named for the Scottish inventor, James Watt, a watt equals 3.412 BTU/hour.

Weatherization is the process of reducing the leaks of heat from (or into) a building. It may involve caulking, weatherstripping, adding insulation, and similar improvements to the building shell.

Wind power systems convert air movement into mechanical or electrical energy. Driven by the wind, turbine blades turn a generator or power a mechanical pump.

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¹²⁶Personal communication with Ned Shamo, Electrical Distribution Superintendent, and Tom Standish, Conservation Specialist, City of Boulder City, Box 367, 900 Arizona Street, Boulder City, Nevada 89005-0367, July 1989.

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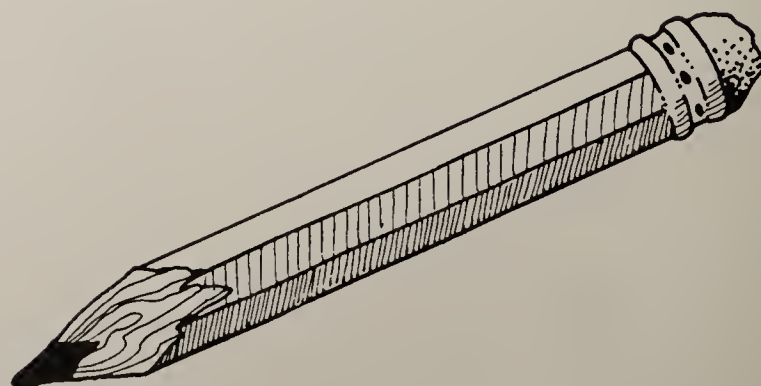
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Notes and Ideas

Notes



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We want to learn from you. Please complete this page, carefully, cut it out, and mail it to Rocky Mountain Institute, 1739 Snowmass Creek Road, Snowmass CO 81654. Your comments and ideas will help us increase the effectiveness of the Economic Renewal Program. If you want to tell us more than space allows, please use more paper.

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Written for community volunteers and leaders, and for economic development professionals, Economic Renewal books divide the formidable work of community economic development into manageable tasks. Providing sensible information that is easy to understand, these books focus the creativity of users, helping them find realistic solutions with a minimum of research.

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implementation workbooks that guide users in developing a course of action, and financial strategies for carrying chosen projects to completion. ER workshop manuals provide general information on how to run meetings, and detailed instructions for conducting the various workshops that constitute the ER community workshop process.

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Rocky Mountain Institute is an independent, nonprofit research and educational foundation located in Old Snowmass, Colorado. Its mission is to foster the efficient and sustainable use of resources as a path to global security.

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